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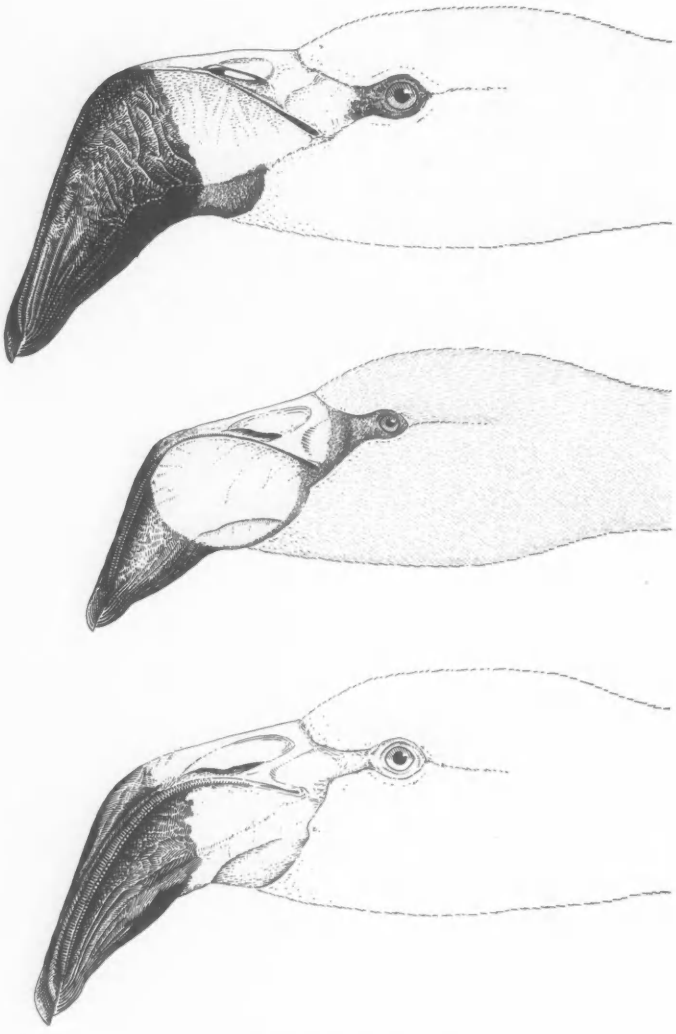

SOUTH AMERICAN FLAMINGOS

PHOENICOPARRUS ANDINUS

PHOENICOPARRUS JAMESI

PHOENICOPTERUS CHILENSIS

Adult males, two-thirds natural size

From drawings by Gene M. Christman

THE CONDOR

VOLUME 60 SEPTEMBER-OCTOBER, 1958 NUMBER 5

THE SOUTH AMERICAN FLAMINGOS

By A. W. JOHNSON, F. BEHN, and W. R. MILLIE

In 1953, Dr. Robert Porter Allen asked one of the authors of this article, A. W. Johnson, to supply him with information on the distribution, numbers, habits, and life-cycles of the three endemic species of South American flamingos. Johnson gave him such information as he had been able to obtain many years ago in the course of three trips to the isolated plateau country of northern Chile which these birds inhabit, and this information was duly reproduced in Allen's masterly monograph entitled "The Flamingos: Their Life History and Survival" published by the Audubon Society in 1956. On reading this book, with its ample documentation of the life-cycles and habits of the other three species of flamingos, we noted that the information regarding the South American species was scanty and unsatisfactory. Then we noted the following remarks (pp. 30–31) with reference to James' Flamingo (*Phoenicoparrus jamesi*) which the senior author, in company with J. D. Goodall and R. A. Philippi B., had looked for in vain on all three of their expeditions.

"Thus the mystery that surrounds this strange, three-toed, little highland flamingo today is matched by an equally obscure history that goes back more than a century . . . The most astonishing fact concerning *Phoenicoparrus jamesi* is that its habits and nidification have never been described. No actual breeding sites, past or present, are known . . . Although the fact that *jamesi* has not been observed for many years may be a result of its isolated range . . . we cannot but wonder if James' flamingo still survives. At the moment this would seem to be one of the outstanding mysteries of the avian world."

This statement was too much of a challenge for us to resist, so in spite of the rigors and inclemency of the terrain to be visited, there was nothing for it but to organize another expedition to the remote Andean region of northern Chile where James' Flamingo had been found originally. Accordingly, Dr. and Mrs. Behn, A. W. Johnson, Bryan Johnson, and W. R. Millie left Santiago for the north by pick-up truck on January 14, 1957.

In the course of our five-week expedition, we traversed a distance of 5000 kilometres (3125 miles) by pick-up, 4-wheel drive vehicle, and mule back (fig. 1), and we visited almost every possible flamingo habitat in the mountains of northern Chile from the extreme south of the Province of Antofagasta (southern tip of Salar de Atacama, lat. 23° 45′S) to the Department of Arica close to the Peruvian border (Salar de Surire, lat. 18° 50′S). In addition we made an excursion across the border into an uninhabited section of southwestern Bolivia to Laguna Colorada (Red Lake), located at lat. 22° 15′S, long. 67° 95′W, which is at an altitude of 14,800 feet. It was there that we found the main object of our quest—the long lost and elusive James' Flamingo.

On arriving at this lake on January 22, 1957 (fig. 2), we found flamingos feeding in great abundance in stretches of shallow water all over the lake, and on examining them with our glasses we came to the conclusion that Chilean and Andean flamingos (*Phoenicopterus chilensis* and *Phoenicoparrus andinus*) were present in approximately equal numbers. After some time, we noticed that in a small group of about 30 flamingos, one bird seemed to be somewhat smaller and whiter on the back than the others. Because of the strong light and multiple reflections on the water it was impossible to be sure, so

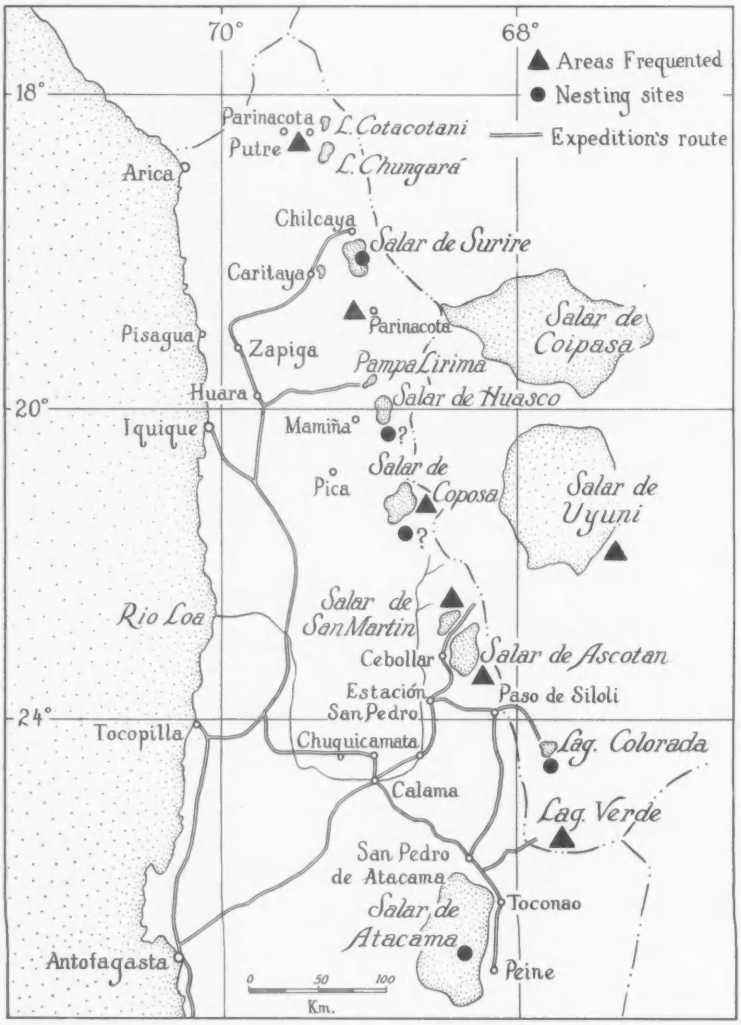

Fig. 1. Map of northern Chile and adjacent Bolivia where flamingoes were studied. See key above.

we approached cautiously and chanced a shot at about 200 yards. The bird took flight with the rest but it soon dropped, and by the time we could launch our rubber boat and reach the spot it was dead. The dark brick-colored legs and yellow area on the bill (see frontispiece) showed us immediately that we had found *Phoenicoparrus jamesi*. This specimen proved to be an adult female in full breeding plumage.

Later while walking around the lake we met a Quechua Indian who told us that he had just arrived from the interior and that it was his custom to come once a year with his family and settle on the shores of the lake to gather flamingo eggs for sale in the

Fig. 2. Upper: panorama of Laguna Colorada, in western Bolivia.
Lower: partial view of flamingo nesting colony.

villages of the hinterland, where they were very much prized for food. We asked him to show us the nesting colonies, but he replied that they were out in the middle of the lake and very difficult to reach, and that "tenderfeet" like ourselves would never be able to get there. Finally, on our assuring him that we would not interfere with his taking the eggs or scare the birds away by shooting at them, he agreed to take us at our own risk.

Fig. 3. Egg of *Phoenicoparrus jamesi,* in nest, with egg of *P. andinus,* held, for comparison.

Early next morning we set out across the lake through shallow water, towing the boat with our equipment and tapping the bottom in front of us with the oars as we advanced to avoid falling into occasional bottomless pits where subterranean geysers poured their waters into the lake. It was heavy going, as the thin crust of salt which formed a sort of false bottom to the lake gave way under our weight at every step and cut gashes in our ankles and legs. Finally, after wading nearly two kilometers, we reached a large island of salt with "cliffs" facing the open water and a large expanse of low-lying, level ground (crystallized sulphate of soda) beyond. Traversing this, we soon found ourselves in difficulties as the hard surface proved to be interspersed with long strips or belts of salty slime of uncertain depth through which we had to stumble and flounder with great physical effort.

Finally we reached firmer ground, topped a salt-bluff and there before us, less than 50 yards away, was a veritable paradise of flamingos, a nesting colony of at least 4000 birds. The birds were standing in all directions and postures, sitting on their nests, or walking and feeding with stately dignified gait along the adjacent stretches of open water! On seeing us appear thus suddenly from behind the bluff, they all rose into the air, filling the sky with their beautiful roseate hues, their dark wings and long necks extended and legs stretched out behind them. However, after a while, on our remaining quiet, the majority decided to return and we were able to admire them at close quarters. As before, the Chilean and Andean species were present in approximately equal numbers, but we were also able to identify a very small minority of *Phoenicoparrus jamesi.* A

narrow strip of deep slime still separated us from the colony, and this we were unable to cross. We accordingly decided to go back for the boat, but by the time we reached it the imminence of the regular afternoon thunderstorm, coupled with the effects of the altitude on our physical endurance, caused us to change our minds and set out for the shore.

Early the following morning we were on our way again, but on picking up the Indian guide we learned from him that some of his relatives were already at the colony gathering eggs, and so we decided to change our plans and visit a second colony of which he also knew. Conditions in this second colony, which consisted of about 3000 birds, were similar to those at the colony we had visited the day before. The numbers of Chilean and Andean flamingos were approximately equal and there were in addition not more than 20 to 25 pairs of James' Flamingo. As we had noted previously all three species were nesting together without separation or segregation of any kind. This habit of communal nesting posed a further problem: how to distinguish the eggs of one species from those of another. There was no alternative but to wait for the individual owners of the nests to return, identify them at reasonably close range with our glasses, and then wait until another member of our party could reach the spot and point to the particular nest we were watching. By this means, we eventually identified 18 nests of *Phoenicoparrus jamesi*, 14 of *P. andinus*, and 13 of *Phoenicopterus chilensis*. Later we learned to distinguish the eggs with relative ease because we found that those of each species were characteristic in shape (fig. 3).

As can be seen from table 1, the eggs of *Phoenicoparrus jamesi* are significantly smaller in both dimensions, while those of *Phoenicopterus chilensis* are appreciably longer and tend to be narrower than those of *Phoenicoparrus andinus*.

Table 1

Measurements of Eggs of *Phoenicoparrus jamesi*, *P. andinus*, and *Phoenicopterus chilensis*

Species	Number	Range	Mean with standard error	Standard deviation	Coefficient of variability
Length:					
Phoenicoparrus jamesi	18	78.1–87.8	82.8±0.58	2.47±0.41	2.6±0.44
Phoenicoparrus andinus	13	80.9–90.9	84.7±0.74	2.68±0.53	3.2±0.62
Phoenicopterus chilensis	14	87.6–100.0	94.9±0.98	3.64±0.69	3.8±0.92
Breadth:					
Phoenicoparrus jamesi	18	48.4–55.2	51.1±0.45	1.92±0.32	3.7±0.62
Phoenicoparrus andinus	13	52.8–57.2	54.3±0.34	1.21±0.24	2.2±0.44
Phoenicopterus chilensis	14	50.0–56.5	53.5±0.46	1.70±0.12	3.2±0.60

The nests were roughly formed, conical mounds of mud averaging 45 to 50 cms. at the base and 28 to 30 cms. at the rim, but they were only 10 cms. high. The average distance between nests was about 6 to 8 cms. It was absolutely impossible to distinguish the nests of one species from those of another either by size, shape, or material used. As already stated, there was no segregation of any sort and individuals of *Phoenicoparrus jamesi* were observed sitting on their nests with both *Phoenicopterus chilensis* and *Phoenicoparrus andinus* as next door neighbors. Of the 1500 to 2000 nests comprising the two colonies (there was also a third colony farther around the lake which we did not visit) not one contained more than a single egg or chick and our guide insisted that in all his years of collecting the eggs for sale he had never seen a nest with more than one egg.

While at the colony it was interesting to observe the curious manner in which the flamingos settled on their eggs. Approaching on foot, they would straddle the nest, spread

their legs wider and wider and suddenly let themselves drop onto the nest, shifting themselves until they had arranged the egg to their satisfaction. The legs remained doubled under the body, with the shins projecting backward nearly up to the pelvis.

By the time we had collected the eggs, taken photographs and measurements, and obtained samples of water, slime, mud, and other materials, it was well past three o'clock and the usual afternoon thunderstorm had begun. Long before we reached the shore the rain had turned into sleet and then to hail, and on our way back to camp it started to snow. Such is the habitat of the South American highland flamingos!

IDENTIFICATION

Once one has become familiar with the birds in the field, it is easy to distinguish *Phoenicoparrus andinus* from *Phoenicopterus chilensis,* even when the color of the legs cannot be determined with certainty, by the much greater amount of black visible on the primaries of *Phoenicoparrus andinus* when the wings are folded and by the vinaceous areas on its neck. *Phoenicopterus chilensis* looks pinker, especially on the back, but there is no apparent difference in the size of these two species. To positively identify *Phoenicoparrus jamesi* from a distance is decidedly difficult, as the smaller size of that species cannot be determined with certainty in the strong light which usually prevails in their habitat and, although in general the bird looks much less roseate than *Phoenicopterus chilensis,* it is easy to confuse it with immature *Phoenicoparrus andinus* which are similar in size and lack the vinaceous areas on the neck which characterize the adults. However, at close range *Phoenicoparrus jamesi* can be distinguished immediately by its dark, brick-red legs and the smaller bill with large areas of yellow (see frontispiece). Incidentally, it should be mentioned that all sketches of the bill thus far published are inaccurate. This may be due to fading of the colors in the bills of the museum specimens which are 60 or more years old.

Our guide, Juan Villca, was able to distinguish the three species at a glance and called them respectively "Guaichete" (*Phoenicopterus chilensis*), "Tococo" (*Phoenicoparrus andinus*), and "Chururo" (*P. jamesi*). He stated that sometimes a few "parinas" (flamingos) of another kind known as "Jetete" were also to be seen, and that these could be distinguished from the others by their whiter wing-coverts and by the absence of the wine-color on the neck. Although the remote possibility that a fourth species of flamingo does in fact exist in these desolate wastelands should not be discarded altogether, and in spite of our guide's assurance that a few might be seen at the nesting colonies, it is our impression that the "Jetete" corresponds to immature specimens of *Phoenicoparrus andinus* which, as we learned from experience when we later shot one, mistaking it for an adult *P. jamesi,* cannot be identified at sight with any degree of certainty.

A further point of interest is that the possibility of sexual dimorphism in James' Flamingo should not be too readily discarded. While watching small groups of *Phoenicoparrus jamesi* feeding in the shallow waters of the lake we noticed on more than one occasion that they were accompanied by a few larger birds which, on account of the vinaceous color on parts of the head and neck, we took to be *P. andinus*. However, these larger birds seemed to be especially interested in the smaller ones and on one occasion we saw an attempt at copulation between birds of different sizes. As the specimen we shot proved to be an adult female, it is possible that these larger birds are in reality males of the same species. Further investigation along these lines and the capture of an adult male *Phoenicoparrus jamesi* is much to be desired.

FOOD AND FEEDING

On several occasions we saw flamingos of all three species feeding at sufficiently close range to enable us to determine the details of their movements. The head and neck are submerged until the bill rests on the bottom; the bill is then drawn toward the feet with a slight swinging motion, followed, in some cases, by the bird stepping backward and continuing the motion without raising the head. On examination, the mud where the birds had been feeding was found to be covered with irregular, wavy lines, usually in the form of an "S" or double "S," about 3 cms. wide and 1 cm. deep. These were blotted out at intervals by the impressions left by the toes and webs of the feet. These same wavy lines were also observed on the muddy bottom in the immediate vicinity of the nesting colonies and our guide assured us that he had often seen the birds sitting on their nests and feeding in the usual way with the head and part of the neck completely submerged!

Analyses of samples of this mud and of the formalin-preserved stomach contents of the three flamingos which we shot show the presence of the silicaceous skeletons of more than 20 different species of diatoms mixed with large quantities of sand, but there is no trace of larger organisms of any kind. Nevertheless, it appears to us that the possibility of the birds' eating larger organisms should not be summarily dismissed, as our samples were necessarily limited in number and in addition it is difficult to explain the purpose of the row of small hooks on the sides of the flamingo's tongue unless larger, macroscopic organisms such as small crustaceans or molluscs also form part of the normal diet. However, even if this surmise is correct, it is evident that no food larger than a pea can be consumed as the bill, despite its large size and complex shape, can be opened only about half a centimeter at the tip.

Samples of the lake water taken between 8 and 9 a.m. were found to have a temperature of 12°C. and a pH of between 8 and 9. When analyzed in the laboratories of the University of Concepción by Professor Anibal Pinto Alvarez, these samples gave the following results:

	Grams per liter
Sodium chloride	59.32
Sodium sulphate	21.41
Magnesium sulphate	2.85
Calcium bicarbonate Sodium and aluminum silicate Iron Sodium borate	9.48

These same salts form a kind of false bottom over the greater part of the lake and also crystalize in quantity around its edges. Analyses made in the same laboratory gave the following chemical composition of these salts:

	Per cent
Sodium sulphate	66.62
Sodium chloride	3.50
Water	29.08
Insolubles	0.30
Other substances	0.50

ORIGIN OF THE RED TINT OF THE LAKE WATERS

The name "Laguna Colorada" (Red Lake) has been attributed to the pink plumage of the flamingos which inhabit it. This, in our opinion, is incorrect. There is no doubt, however, that the water does have a distinct reddish tint which is accentuated by reflec-

tions from the surrounding brownish hills until it appears brick-red. The chemical analyses of the water and salts point to the presence of iron in the form of oxides and chlorides, but samples of slimy water selected because of the intensity of their reddish color, when studied under the microscope, betray the presence of innumerable, spherical, orange-colored microorganisms which have been identified by the Botanical Institute of the University of Concepción as "unicellular cyanophyceous algae of the genus *Aphanocapsa*, rich in phycoerythrin pigments."

It would seem quite possible that these organisms, which undoubtedly give the water of this lake its characteristic reddish tint, also entered into the composition of the equally characteristic reddish lipopigments of the adipose tissue of the flamingos which we shot. These algae are likewise probably responsible for the deep orange-red yolks, not only of the flamingos' eggs which we blew, but also of the chickens' eggs which we bought from the guide's family. It may be possible that the delicate pink hues of the flamingos' plumage are in some way derived from this same phycoerythrin and that the fading of these tints when the birds are kept in captivity may be due to a lack of this coloring element in their food.

DISTRIBUTION

After visiting on this trip the salt lakes of Atacama, Ascotán, and San Martín in the province of Antofagasta, Laguna Colorada and Laguna Verde in western Bolivia, and Pampa Lirima, Tranque Caritaya, and Surire salt lake in the Province of Tarapacá (fig. 1), and taking into account Johnson's observations made years ago at Salar de Huasco, Collacagua, and Isluga in the Province of Tarapacá and lakes Parinacota ("Lake of the Flamingos") and Cota-Cotani in the highlands of the Department of Arica, we are of the opinion that the distribution within Chilean territory of the three species of South American flamingos may be summarized as follows:

The birds are to be found on the salt lakes and on certain lakes of relatively fresh water from the extreme south of Salar de Atacama (lat. 23° 45′S, long. 68° 15′W) to Lago Parinacota (lat. 18° 15′S, long. 69° 15′W) in the cordilleras of Arica. Their nesting sites, however, would appear to be confined to two points on Salar de Atacama, certain small lakes in the mountains directly to the east, possibly Salar de Ascotán (although we were not able to establish this and it is likely that the renewal of operations for the extraction of borax has caused the birds to abandon this site), and in the province of Tarapacá at Salar de Coposa, Salar de Huasco, Lago Parinacota (where *Phoenicoparrus jamesi* was originally found in 1850; not to be confused with the lake of the same name in the Department of Arica already mentioned), and Salar de Surire.

It should be borne in mind, however, that these data on nesting distribution refer to flamingos in general and that very few people are capable of distinguishing *Phoenicoparrus jamesi* from the other two species. Apart from Laguna Colorada, we only saw *P. jamesi* at Salar de Ascotán and Salar de Surire (in both instances in very small numbers), and up to the present its only known nesting site must be listed as Laguna Colorada, western Bolivia.

At none of the locations visited did the total population exceed 3000 flamingos, and of these only a very small minority of not more than 6 or 8 per cent at most was *Phoenicoparrus jamesi*. Of the two larger species, *Phoenicopterus chilensis* predominated in the southern section of the range, gradually becoming fewer in numbers than *Phoenicoparrus andinus* as we advanced northward. Although flamingos were seen by us and are known to breed on Salar de Atacama at an altitude of only 8500 feet, and a few were observed at Caritaya at an elevation of 12,000 feet, the bulk of the population lives at altitudes between 14,000 and 16,500 feet.

Flamingos have occasionally been reported from Salar de Maricunga and "El Negro Francisco" in the Andes in the Province of Atacama which is immediately to the south of the southernmost point reached by us. In all probability, however, these observations refer to the migratory *Phoenicopterus chilensis* and there is as yet no evidence of any species of flamingo nesting in this region. On the other hand, there is no doubt whatever that the flamingo population of the plateau country of western Bolivia, centering around the immense salares of Uyuni and Coipasa (fig. 1), is considerably larger than that found in Chilean territory, and it is equally certain that the main point of concentration of these birds in the more southerly sector of their range (between latitudes 22° and 24°S) is in Laguna Colorada.

What is now required to improve our knowledge of the distribution, habits, and life-cycles of the South American flamingos is a systematic survey of all possible habitats in the high plateau country comprising the more northerly reaches of western Bolivia, the extreme south of Peru, including in particular the Lake Titicaca region, and certain mountain fastnesses of northwestern Argentina. It is to be hoped that some of our colleagues in these three bordering countries will undertake such a survey in the very near future.

MIGRATION AND SEASONAL MOVEMENTS

Reverting to our findings at Laguna Colorada, there is another point which is of interest. At the northeast corner of the lake a series of hot springs of volcanic origin pour their waters into those of the lake. Day and night water temperatures taken during our four-day stay showed an unvarying temperature of 22°C., and the pH also remained stable between 5 and 6. This was in contrast to the water in other parts of the lake which had a temperature of 12°C. and a pH of 8 to 9. A chemical analysis of these waters gave the following results:

Chlorides	0.175 grams per liter
Nitrites	Trace
Ammonia	Trace
Nitrates	none
Sulphates	none
Heavy cations	none

It would seem to us that the presence of these warm, sweet waters gives the clue to the apparent ability of the Andean flamingos to withstand the rigors of the plateau winters, where temperatures may drop during the nights to —20°C., or even —30°C. Our guide assured us that as soon as the rest of the lake freezes over the entire flamingo population moves to the northeast corner, where the water never freezes. The birds remain there all through the winter, a fact which was afterwards confirmed from other sources of information. At Ascotán and Surire salt lakes, we found similar in-flows of warm water and such conditions no doubt exist at other points of the essentially volcanic regions which these flamingos inhabit. It is reasonable to assume, therefore, that it is these ultra-specialized ecological conditions, together with the possibility of the birds withdrawing temporarily during periods of extreme cold to similar conditions at a lower altitude, such as the Salar de Atacama, which have given rise to and permit their sedentary way of life and account for the fact that neither *Phoenicoparrus andinus* nor *P. jamesi,* notwithstanding their strong powers of flight, has ever been reported from points outside the restricted triangle of frigid and forbidding plateau country which constitutes their known geographic range.

What these conditions do not account for, however, is that whereas these two species apparently remain in this one specialized area throughout the year, the closely allied

Phoenicopterus chilensis, which, as has been seen, lives and nests in intimate association with them, nevertheless ranges over half the continent and is found all along the crest of the Andes from Lake Junín in Perú to Magallanes in southern Chile. This species also appears at times, although never as a resident, on the Pacific coast of central Chile (and possibly also of central Perú), the Atlantic coast of Argentina, the Falkland Islands and the island of Tierra del Fuego. *Phoenicopterus chilensis* recently has been reported as nesting in an estuary at the extreme northern tip of the island of Chiloe in southern Chile but a visit will have to be made to this site before so unexpected a nesting record can be regarded as definite.

Whether or not this last report is correct, how can we explain so strikingly contradictory a response to the same ecological conditions? Might it not be that *Phoenicopterus chilensis* has been more successful in building up a larger total population, that it has consequently spread over a wider area, and that the part of the population which lives and nests in intimate association with *Phoenicoparrus andinus* and *P. jamesi* does in fact remain in the plateau territory throughout the year, but that the remainder, living and nesting in areas where the tempering influence of hot springs is not available, has found itself obliged to migrate in winter to regions where climatic conditions are less severe?

In any case, the climatic range which flamingos are able to withstand is truly remarkable. Imagine the contrast between the torrid heat of Lake Natron or Lake Elmenteita in the rift valley of Africa almost on the Equator, where Leslie Brown has recently found flamingos nesting in great numbers, and the night temperatures in winter of —20°C. or even —30°C. which are usual in the 14,000 to 16,000-foot habitat of the two Andean species!

CONSERVATION OF THE SPECIES

We have mentioned that at Laguna Colorada we witnessed the collecting of hundreds of flamingo eggs by local people of Quechua origin. This is done by wading out to the colonies, placing the eggs on llama or sheep hides, and half floating and half dragging them through the slime to the shore of the lake. The eggs are then packed in boxes lined with dry grass and taken on the backs of donkeys or llamas to the villages of the interior, the nearest of which is a full two days walk by Indian measure. Here, due to the near-starvation conditions under which the inhabitants live, the eggs are highly prized for food and find a ready sale.

Our guide admitted that he belonged to a Quechua family that came every year and established itself from December to February on the otherwise uninhabited shores of the lake for the express purpose of collecting flamingo eggs. He said that the colonies were visited and the eggs removed every 12 to 15 days and that the birds went on replacing their eggs until February, after which they were left alone, as at that time, which is at the end of the rainy season, the villagers were all very busy harvesting their meager crops.

According to reliable information received from Mr. Jeldres of Concepción and confirmed by an old resident of the village of Peine, the eggs of the flamingos are also taken at the Salar de Atacama, Chile. However, in this place the eggs are taken only once a year; the visit to the colonies is made the occasion for a sort of annual pilgrimage on the part of the local inhabitants. Because of the higher standard of living in Chile, as compared with Bolivia, it is quite likely that this is so.

Notwithstanding these depredations, which doubtless have been practiced by these indigenous peoples for generations, there is no tangible evidence of any marked diminution in the flamingo population and certainly no immediate danger of its extinction.

No doubt the birds have been favored by the remoteness of their habitat, by the sparse human population, and also by the great difficulty of access to their nesting colonies, which must deter all but the most resolute human visitors and which certainly deters all other predatory animals.

Further, except for the nesting hazard, the birds are virtually free from danger, as the local inhabitants are too poor to possess firearms in any quantity and too few to represent a menace. The open nature of the country, together with the great height of the birds and their natural wariness, also operates in their favor. In addition, at present there is little or no likelihood that the terrifying whine of jet planes, which so seriously disturbed the life cycle of the American Flamingo (*Phoenicopterus ruber*) in the islands of the Caribbean, will ever invade the vast frigid silences of the remote Andean domain of its South American cousins, *Phoenicoparrus andinus, Phoenicopterus chilensis,* and *Phoenicoparrus jamesi.*

SUMMARY

Information concerning the habits and life cycles of the three endemic species of South American flamingos is notoriously scanty and unsatisfactory. In particular, practically nothing is known of the little three-toed highland flamingo, *Phoenicoparrus jamesi.* This paper tells of a successful attempt to locate this bird and describes the finding of a nesting colony of this species for the first time. Eighteen nests of James' Flamingo were positively identified in a mixed colony of approximately 3000 flamingos in Laguna Colorada in the high plateau country of western Bolivia.

Measurements of the eggs of all three species are given and also the results of the chemical analyses of the samples of water, slime, mud, and salts which were obtained at the colony. Observations showed that all three species are bottom feeders, and the samples indicate that their food consists of diatoms of at least 20 different species.

In the course of five weeks in the field, almost every possible flamingo habitat in the Andes of northern Chile was visited, and much new information as to distribution, habits, and seasonal movements was obtained.

The suggestion is made that the lack of any record of the occurrence of the Andean and James' flamingos outside a restricted area of frigid and forbidding plateau country may be accounted for by the in-flow of warm waters of volcanic orgin at one point or another of almost all the salt lakes visited. It is admitted, however, that this does not explain the contrast presented by the wide-ranging movements of the Chilean Flamingo, which is found nesting in intimate association with the other two species.

We conclude that, notwithstanding the practice of the indigenous Aymará and Quechua peoples of the plateau country of systematically removing flamingos' eggs for food, there is no evidence of a pronounced diminution in the numbers of these birds and certainly no imminent danger of their extinction.

Santiago, Chile, December 12, 1957.

OBSERVATIONS ON OCEANIC BIRDS IN THE GULF OF PANAMA

By C. RICHARD ROBINS

While studying marlin and other gamefishes in the Gulf of Panamá, I had an unusual opportunity to observe oceanic birds. Recent publications by Wetmore (1946, 1952, 1957) on the avifaunas of various islands in this region deal principally with land birds, and his brief mention of oceanic species suggests that additional notes on such forms are desirable. Further, the Gulf of Panamá is at the northern extreme of the area studied by Murphy (1936). Finally, Sturgis (1928) had only limited opportunity to observe oceanic birds and included but few notes on them.

I am indebted to Kenneth L. Middleton and Frank J. Violette of the Panamá Marlin Club and to Edward S. Corlett, III, and Charles Helmly, Jr., of the Miami Rod and Reel Club, for making the trip possible. Thanks are also due Oscar T. Owre of the Zoology Department of the University of Miami and Alexander Wetmore of the United States National Museum for encouragement and for advice concerning the manuscript. All of the observations were made from Mr. Middleton's boat, the *Soltura*. The few specimens taken have been deposited in the collections of the University of Miami.

The observations cover the period from July 15 to July 26, 1957. Balboa was the point of departure and return. Our efforts were concentrated in the Pearl Island Archipelago (see Murphy, 1936:320, for a map of this region) and in the waters off Piñas Bay (lat. 7° 32′N, long. 78° 12′W), an anchorage near the Colombian border. On July 22, we were 25 miles south-southwest of Piñas Bay and in view of Cabo Marzo and Punta Juárez, Colombia. This was the southernmost point reached during the trip. In the Pearl Islands our anchorage was inside of Cocos Point, Bahía Santelmo, at Rey Island. San José, Galera, Camote, all mentioned in the text, are islands in the Pearl Island Archipelago. Descriptions of them are rather fully presented in the appropriate Pilot and by Wetmore (1946). Morro de Piñas and Morro Centinela are at the entrance to Piñas Bay. In the southern region most observations were made between Piñas Bay, a deep reef some 10 miles to the northeast, and a drift line 20 to 25 miles southwest of the bay.

Trolled baits attracted many birds to the boat and considerably facilitated observation. Boobies, especially, tirelessly pursued the baits and not infrequently became fouled in the lines and had to be brought aboard to be released. An account of the species observed follows.

Puffinus griseus. Sooty Shearwater. These shearwaters were uncomon in the region. Several were very active during the height of a storm on July 19, the only day on which more than a solitary individual were seen. The other seven records of this species were scattered from near Taboga just off Balboa to the drift line about 28 miles south-southwest of Piñas Bay. This species never paid any attention to the boat, the bait, or even to the wake. On July 25, a shearwater was seen resting on the water within 50 feet of the rocky isle of Camote. This specimen, a male with testes which measured 16×10 mm., was captured with a dip net without difficulty. There was little fat.

Puffinus lherminieri. Audubon's Shearwater. Large tide rips and drift lines were found almost over the 100 fathom curve some 20 to 25 miles southwest of Piñas Bay. Here about 15 Audubon's Shearwaters were seen at various times on July 21, one was seen on July 22, and three were seen on July 23. This species was quite easily distinguished and could be identified at a considerable distance. It would appear to be very scarce in the Gulf of Panamá at this season for none was seen elsewhere on the entire trip. Like the petrels, and unlike the boobies, pelicans, and frigate birds, this species generally ignored the boat and did not fish in the wake, although it would pass the boat at close range if such were its course.

Oceanodroma tethys. Galápagos Petrel. From the time we saw the first Galápagos Petrel about 18 miles southeast of Taboga on July 15 until we logged the last observation of the species some eight

miles off the same island on July 26, this was one of the most frequently observed species on the trip. Never numerous, one or two could be located almost every hour off shore. As many as seven or eight were seen at one time along a drift line some 20 miles south-southwest of Piñas Bay, but they seemed to be a collection of individuals attracted to a fishing area rather than a flock. This species never followed the boat or its wake, although frequently individuals would fly by at close range, nor did it associate with the flocks of sea birds that followed the schools of tuna porpoises.

One petrel flew aboard shortly after dark, on July 24, while we were at anchor at Bahía Santelmo, Rey Island. The specimen, a female, was collected. The next night two more flew aboard at the same spot. The first petrel left for shore within a few minutes; the second flew out to sea shortly after dawn the next morning. Several were noticed on other boats on these nights. None of these individuals regurgitated or seemed to mind handling, and on another boat one could be seen perched quietly on a seaman's shoulder. None was noted within four or five miles of this anchorage during the day and there was no storm to account for their actions. The triangular shape of the white rump patch, obvious when the bird is held in the hand, is not evident on the bird in flight.

Loomelania melania. Black Petrel. This species was recorded only three times during our trip. On July 18 and 19, an individual was seen at the deep reef northwest of Piñas Bay, and two or three were seen on July 23 about 25 miles southwest of Piñas Bay in an assemblage of birds following a group of more than 300 porpoises. In each instance, the petrels shied away from the boat and were difficult to observe. Probably many of the unidentified petrels were of this species.

Pelecanus occidentalis. Brown Pelican. Brown Pelicans were numerous around the entrance to Balboa harbor, in the Pearl Islands, and along the mainland from Garachiné Point to Piñas Bay. We did not see them more than five miles from land. The largest concentrations were at Galera (200 birds) and at Piñas Bay (300–500 birds). At Piñas Bay, these flocks would gather on the two morros, or small, rocky islets, and roost high in the trees of the tropical forest that capped these islands. From the outer limbs of these trees the pelicans would dive directly into the water which, although at the edge of the shore, was 20 or 30 feet deep. At dusk, and to a lesser extent at dawn, the pelicans joined the concentrations of Blue-footed Boobies and soared high over the morros and Piñas Bay. Like the boobies, the pelicans gathered around the boat and tirelessly followed the baits. They eagerly fished in the wake and, with the boobies, a flock of pelicans diving offshore usually marked a school of bonito (*Euthynnus* sp.).

Sula dactylatra. Blue-faced Booby. On July 21, when some 20 miles at sea off Piñas Bay, one adult Blue-faced Booby came to the boat with a flock of ten Brown Boobies. The species was not seen again by us.

Sula nebouxii and *Sula leucogaster*. Blue-footed Booby and Brown Booby. These two species are best discussed together. They were the most numerous oceanic birds in the Gulf of Panamá during our visit. One or both species were in sight almost every minute from the time we left Balboa harbor until our return. Brown Boobies rarely failed to come by the boat where they pursued the baits and followed the wake. The Blue-footed Boobies also came to the boat, but they generally left after five or ten minutes to fly off elsewhere. Although both species would be around the boat at the same time, the lines of approaching birds were, with few exceptions, not of mixed species. However, Brown Pelicans would often tag along with either species. Both kinds were abundant in the Pearl Islands and many thousands of birds were represented. The Blue-footed Booby was especially abundant on the rocky isle of Camote and at Galera, and it was easily the most numerous species along the coast from Garachiné Point to Piñas Bay. Over the drift lines 20 to 25 miles southwest of Piñas Bay, the Brown Booby seemed more numerous. The numbers of both species diminished sharply from the Pearl Islands northward to Balboa, although neither could be considered scarce even there. About 30 Brown Boobies were diving among a school of porpoises for the 45 minutes that we followed it. Excluding the concentrations around islands and along the coast of the mainland near Piñas Bay, the boobies traveled in small flocks, usually in single file or in a staggered line. The Brown Booby, under these circumstances, most frequently occurred in groups of three to five, and less often in groups of five to 15. Single birds were very common. On the other hand, single Blue-footed Boobies were rarely recorded and their flocks were usually of 10 to 25 birds. Wetmore (1946:11) also records Brown Boobies (= Colombian Booby) in groups of three or four, and (Wetmore, 1957:14) singly and in pairs. In

connection with this account, it should be noted that Wetmore (1946:10) had but one record of the Blue-footed Booby from San José.

Phalacrocorax olivaceus. Olivaceous Cormorant. Wetmore (1946:11–12; 1952:9) recorded large bands of cormorants from San José Island of the Pearl Island group and near Taboga. The scarcity of this species in July is therefore of interest. We recorded it but once, a single bird at Morro de Piñas on July 18. On our return to the Pearl Islands I watched especially for this species but without success.

Fregata magnificens. Magnificent Frigate-bird. Frigate-birds were seen every day, not only around each island visited but also on our visits to the drift line two to 25 miles southwest of Piñas Bay. Large concentrations of about 100 soaring birds were seen at Galera, a known nesting station (Murphy, 1936:322), and 50 were counted soaring over Camote, a barren rocky promontory. Individuals would follow the boat occasionally picking up scraps of fish from the wake while flying just over the surface. They pursued Brown Boobies with some success, but the Blue-footed Booby, a swifter and more powerful flier, rather easily eluded them.

Casmerodius albus. Common Egret. Although not pertinent to a discussion of oceanic birds, the occurrence of a Common Egret 18 miles south of Taboga, apparently flying from San José Island to Taboga or to the mainland, deserves mention. This species, along with the Yellow-headed Caracara (*Milvago chimachima*), is common on the beaches of Rey Island.

Stercorarius pomarinus. Pomarine Jaeger. On July 26, as we passed the outer buoys some three miles from the entrance to Balboa, a Pomarine Jaeger flew rapidly to the boat and stayed at very close range for five minutes before it veered off. The Gulf of Panamá is well within the recorded wintering range of the species, but its occurrence here in July was unexpected. Perhaps, as in many species of gulls, shore birds, and ducks, an occasional individual does not migrate northward.

Creagrus furcatus. Swallow-tailed Gull. One was seen at the deep reef almost ten miles northwest of Piñas Bay on July 18. Eisenmann (1955:33) lists it as "casually to Panama (?)."

Sterna anaethetus. Bridled Tern. This offshore species avoided our boat to such an extent that observation was difficult. Individuals were never seen within four or five miles of land and they were much more numerous when we were 10 to 25 miles at sea. Four were seen on July 26 between San José and Taboga islands, and four were seen on July 16 at Troloppe Rock (lat. 8° 7′N, long. 78° 30′W). From Garachiné Point southward, especially over the deep reef northwest of Piñas Bay and in the drift area southwest of Piñas Bay, the species was, in contrast, quite common. Here, flocks of as many as 45 birds were seen every day, resting on rafts of drift and feeding among schools of porpoises and fishes.

Thalasseus sp. On July 18, two terns came to the boat just off Morro de Piñas and followed our wake for an hour. On July 23, a pair again followed the boat for more than an hour, 20 miles southwest of Piñas Bay. Of all the species reported herein, this is the only one about the identification of which the writer has some question. The birds were in winter plumage, but their light orange bills and white foreheads and lores would indicate that they were Elegant Terns (*T. elegans*). Compared to the Royal Tern (*T. maximus*), with which I am very familiar, they seemed decidedly smaller, but size estimates are difficult at sea when no comparable birds are near.

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The Marine Laboratory, University of Miami, Miami, Florida, December 15, 1957.

THE TRACHEA OF THE HAWAIIAN GOOSE

By PHILIP S. HUMPHREY

The unfortunate death of one of a pair of S. Dillon Ripley's Hawaiian Geese (*Branta* ["*Nesochen*"] *sandvicensis*) has given me the rare opportunity of examining a fresh specimen of this interesting species. Other than Miller's (Univ. Calif. Publ. Zool., 42, 1937:1–80) study of the "Structural Modifications of the Hawaiian Goose (*Nesochen sandvicensis*)," there has been no study of the morphology of the Hawaiian Goose. Miller's study was confined to an analysis of hindlimb locomotor adaptations. It is regrettable that the specimen available to me was damaged so severely as to make studies of pterylosis, digestive tract, and certain other aspects of the anatomy of this specimen impossible. The posterior half of the trachea, however, was undamaged. Since this structure and its associated musculature have never been described for the Hawaiian Goose, I take this opportunity of making a record of them.

This specimen of the Hawaiian Goose was a year old and probably a male, although I was unable to identify the testes with any certainty. Post-mortem examinations revealed indications that the bird may have been weakened by hepatitis before being attacked and partly eaten by rats. The lining of the empty gizzard was bright chrome yellow in color, and the gall bladder was greatly enlarged. The death of one of Dr. Ripley's Australian Black Swans (*Cygnus atratus*) in 1957 was attributed to hepatitis; this bird had an enlarged gall gladder and a yellow gizzard lining. The fact that one of the Hawaiian Geese was attacked by rats while none of the many healthy birds in the pen was attacked lends further support to the idea that the goose was in a weakened condition.

I am grateful to Dr. Ripley for his helpful suggestions and for permission to examine this valuable specimen. For his help in making a detailed photographic record of the anatomy of the trachea of the Hawaiian Goose, I am very much indebted to Rudolph Zallinger. I wish to thank Shirley Glaser for assistance with figure 1 and lettering figure 2 and Jean Richards for typing the manuscript. This study was undertaken in the course of a survey, supported by the National Science Foundation, of the anatomy of the trachea of ducks and of the classification of that group.

ANATOMY OF THE TRACHEA AND ASSOCIATED STRUCTURES

Trachea.—The trachea of the Hawaiian Goose extends along the ventral surface of the neck in close association with the esophagus. The trachea diverges from the esophagus approximately 3 cm. anterior to the arms of the furculum and proceeds ventrally along the membrane of the interclavicular air sac at an angle of 45 degrees. At a point 12.9 mm. dorsal to the hypocleideum and 30 mm. ventral to the esophagus the trachea enters the interclavicular air sac and proceeds dorsally at an angle of 45 to 50 degrees from the vertical. Counting from the posterior end of the trachea, tracheal ring 30 lies at the level of the hypocleideum. The trachea touches the anterior dorsal margin of the body of the sternum in passing. The lateral margins of the trachea between the furculum and the anterior margin of the body of the sternum are joined by membranes to the ventrolateral walls of the interclavicular air sac. The dorsal surface of the caudal termination of the trachea is 3 mm. ventral to the esophagus and lies dorsal to a point 30 mm. caudad of the anterior margin of the sternum in the midline (see fig. 1).

The dimensions of the trachea as it passes between the arms of the furculum are: lateral diameter, 10.6 mm.; dorsoventral diameter, 7.9 mm. The trachea gradually decreases in size posteriorly; 10 mm. anterior to the posteriormost extremity of the tympanum it measures 6.4 mm. in dorsoventral diameter and 6 mm. in lateral diameter.

The tympanum may be incompletely fused in this individual. Its measurements are: greatest length along ventral surface, 5 mm.; greatest length along dorsal surface, 5 mm.; dorsoventral diameter at anterior end, 7 mm.; lateral diameter at anterior end, 6 mm.; smallest lateral diameter, 5 mm.; greatest dorsoventral measurement at posterior end of tympanum, 10 mm. Adult specimens of *Anser* and *Branta* have tympanums which are four or five times as long as the tympanum of this year-old specimen of *B. sandvicensis*. I do not have the material to determine the relation of age to variation in fusion and length of the tympanum in geese.

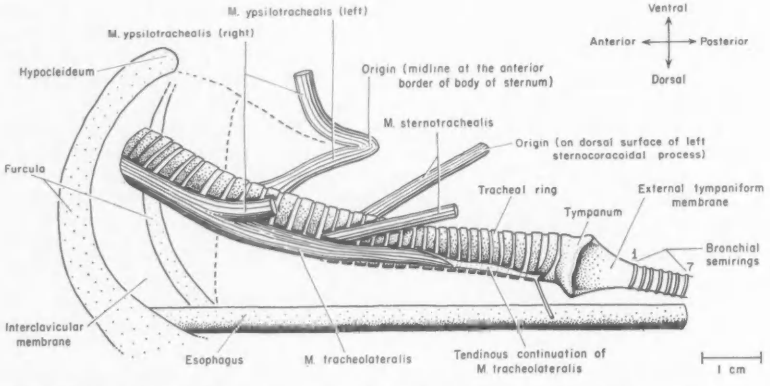

Fig. 1. Lateral view of the posterior end of the trachea of *Branta* (*"Nesochen"*) *sandvicensis*. The trachea has been moved slightly dorsal so that the Mm. ypsilotracheales and Mm. sternotracheales could be shown to better advantage. The ventral limit of the interclavicular air sac between the hypocleideum and the anterior border of the sternal body is indicated by a dashed line.

Bronchi and syrinx.—The right and left bronchi are of equal size and neither is enlarged nor has any enlargements. The right bronchus (the left was not measured) was 3.9 mm. in dorsoventral diameter throughout its length from the first bronchial semiring caudad of the trachea to the posteriormost bronchial semiring. The right bronchus has 7 semirings; there are 6 semirings in the left. Each bronchus diverges from the midline at an angle of about 50 degrees. The bronchi consist largely of transparent membrane; the bronchial semirings are not very prominent. The distance between the middle of the first semiring and the lateral posterior margin of the tympanum (the caudal end of the trachea) is 9 mm.

The paired external and internal tympaniform membranes and their supporting structures comprise the syrinx. The external tympaniform membrane is supported anteriorly by the caudal margin of the lateral wall of the bronchial semiring at the caudal end of the tympanum; this margin measured 9.3 mm. in length. The first bronchial semiring forms the posterior support for the external tympaniform membrane. Compared to waterfowl other than geese, the Hawaiian Goose has an external tympaniform membrane which is very extensive in area. The dorsal and ventral margins of the external tympaniform membranes attach imperceptibly to the corresponding margins of the right and left internal tympaniform membranes, respectively. The internal tympaniform membrane receives support anteriorly from the margin of the mesial wall of the

bronchial opening at the caudal end of the tympanum. The internal tympaniform membranes terminate caudally by fusing with one another in the midline. On looking through the interbronchial opening between the right and left internal tympaniform membranes one can see the ventral surface of the esophagus which is 2 or 3 mm. dorsal to the dorsal margins of the bronchi anterior to the first bronchial semiring. Dorsally and ventrally this interbronchial space opens into the interclavicular air sac.

Tracheal muscles.—The Hawaiian Goose possesses in common with other Anseres two pairs of extrinsic tracheal muscles, Mm. sternotracheales and Mm. ypsilotracheales, and one pair of intrinsic tracheal muscles, Mm. tracheolaterales.

The sternotrachealis is a very narrow, thin band of muscle uniformly 2 mm. in width for most of its length; it is slightly wider at its origin. The origin of the sternotrachealis is on the dorsal side of the anteromesial margin of the sternocoracoidal process of the sternum. The muscle extends 30 mm. anteromesially to its insertion on the lateral surface of the trachea at tracheal rings 18 and 19 (the posteriormost pre-tympanic tracheal ring being counted as the first). The insertion measured 3 mm. in length and its anterior limit was 37 mm. distant from the caudal margin of the tympanum and 17 mm. distant from the posterior limit of the fleshy part of the tracheolateralis. The sternotrachealis inserts on the trachea ventral to the body of the tracheolateralis.

The ypsilotrachealis diverges from the lateral surface of the trachea at tracheal rings 23 and 24 and runs directly to the origin 20 mm. caudad. It is a very thin muscle 3 mm. in width throughout its length. The origins of the two ypsilotracheales meet at the midline at the anterior border of the body of the sternum. The origin of each ypsilotrachealis is 3 mm. in maximum width.

The ypsilotrachealis and the tracheolateralis together extend anteriorly along the lateral surfaces of the trachea and presumably have their anterior attachments on the ventral surface of the cricoid cartilage. Because the anterior part of the trachea was missing in this specimen, the relations of the ypsilotrachealis and tracheolateralis in that region could not be determined.

The tracheolateralis terminates as a narrow tendon on the lateral surface of the trachea at the second pre-tympanic tracheal ring 6.5 mm. anterior to the posterior margin of the tympanum. The fleshy part of the tracheolateralis terminates on the lateral surface of the tenth tracheal ring 19 mm. anterior to the posterior margin of the tympanum. The tracheolateralis passes dorsal to the insertion of the sternotrachealis.

DISCUSSION

I have examined the tracheas of *Branta bernicla hrota, B. canadensis, Anser* (*"Chen"*) *caerulescens caerulescens, A. c. hyperboreus,* and *A. c. atlanticus.* In all these species the trachea diverges ventrally from the esophagus and approaches the hypocleideum before entering the interclavicular air sac. The arrangement of the tracheal muscles, the shape of the tympanum, and the orientation of the bronchi and tympaniform membranes is the same in the Hawaiian Goose and other geese that I have examined except for minor variations.

Although not enough specimens have been examined to enable me to comment on variability, there appear to be two differences between *Anser* and *Branta* with respect to the anatomy of the trachea. These are (1) in the number of bronchial semirings, and (2) in the location of origin and width of the ypsilotrachealis. *"Nesochen"* agrees with *Branta* in both these characters. Whether or not examination of series of specimens of these and additional species of geese will show that these characters consistently reflect the limits of the genera as they are currently understood (Delacour and Mayr, Wilson

Bull., 57, 1945:3–55) remains to be seen. It would be particularly interesting to examine specimens of additional species of *Anser*, including "*Philacte*," "*Eulabeia*," and "*Cygnopsis*."

Specimens of *Branta* and "*Nesochen*" at my disposal had fewer bronchial semirings than did specimens of *Anser*. They also had a narrow ypsilotrachealis originating on the anterior margin of the sternal body near or at the midline. Specimens of *Anser*, with one possible exception, (see fig. 2), had ypsilotracheales which originated anterior to the sternum and were either narrow (2 specimens) or wide (2 specimens).

	Number of specimens	Number of bronchial semirings		Origin of ypsilotrachealis on sternum	Origin of ypsilotrachealis anterior to sternum	Ypsilotrachealis narrow	Ypsilotrachealis wide
Branta sandvicensis	1	6	7	+		+	
Branta bernicla	1	6	6	+?		+	
Branta canadensis	1	7	7	+		+?	
Anser c. caerulescens	1	–	11		+	+	
Anser c. caerulescens	1	–	9		+		+
Anser c. atlanticus	1	?	?	+?			
Anser c. atlanticus	1	–	11		+	+	
Anser c. hyperboreus	1	–	9		+		+

Fig. 2. Number of bronchial semirings and characteristics of M. ypsilotrachealis of several specimens of *Anser* and *Branta*.

Bearing in mind that more material should be examined to determine the variability of these characters, I can conclude that "*Nesochen*" and *Branta* are in structure of the trachea more similar to one another than to *Anser*. This conclusion is in agreement with Miller's (*op. cit.*: 60) statement that "*Nesochen* is most closely related to *Branta* . . . ." With regard to tracheal characters I cannot agree with Miller's statement (*loc. cit.*) that *Nesochen* "is as distinct from *Branta* as is *Chen*." The structure of the trachea of "*Nesochen*" bears out Delacour and Mayr's (*op. cit.*) opinion that the genus should be merged with *Branta*.

SUMMARY

1. The caudal portion of the trachea and tracheal musculature, and the bronchi of the Hawaiian Goose are described.

2. The trachea and tracheal musculature, and bronchi of the Hawaiian Goose are identical (except in minor detail) with those structures in other species of *Branta* and only slightly different from those in *Anser*.

3. The bronchi of *Branta* and "*Nesochen*" each have 6 or 7 bronchial semirings; those of *Anser* each have 9 to 11 semirings.

4. The ypsilotracheales of *Branta* and "*Nesochen*" are narrow and originate on the anterior margin of the body of the sternum near the midline; those of *Anser* may be either narrow or wide and originate (with one possible exception) anterior to the sternum.

5. More specimens of *Branta* and *Anser* should be examined to determine more precisely the variability of their tracheal characters.

6. The structure of the trachea of "*Nesochen*" bears out Delacour and Mayr's opinion that the genus should be merged with *Branta*.

Peabody Museum of Natural History, Yale University, New Haven, Connecticut, January 27, 1958.

SINGING BEHAVIOR AND THE GONAD CYCLE OF THE RUFOUS-SIDED TOWHEE

By JOHN DAVIS

Although the Rufous-sided Towhee (*Pipilo erythrophthalmus*) is a common species over much of western North America, its singing behavior has never been described in detail, and even the published descriptions of its song are brief and inadequate. In this study, singing behavior was observed in the population resident at the Hastings Reservation, two and one-half miles east of Jamesburg, northern Monterey County, California. The gonad cycle was determined for populations resident within a radius of three miles of the Reservation, to see whether any aspects of singing behavior were correlated with events in the gonad cycle. The subspecies with which this paper is concerned is *Pipilo erythrophthalmus megalonyx*, which reaches its northern limits of distribution in northern Monterey County.

ACKNOWLEDGMENTS

I wish to thank the following persons, who generously gave me permission to collect on their ranches: Mr. and Mrs. Levi S. Cahoon, William G. Lambert, Agnes Melin, Al Stopp, and John H. Tregea. The continued support of the Reservation's program by Mrs. Russell P. Hastings made this study possible. The figures in this paper were prepared by Betty S. Davis.

MATERIALS AND METHODS

Most of the material presented has been taken from my field notes, written at the Hastings Reservation between September 22, 1953, and October 13, 1957. In addition, field notes recorded by the following workers at the Hastings Reservation were used: Lowell Adams, John E. Chattin, Floyd E. Durham, Richard J. Hitsch, Everett W. Jameson, Enid A. Larson, Jean M. Linsdale, Alden H. Miller, George M. Scheibner, Charles G. Sibley, Lloyd P. Tevis, Jr., P. Quentin Tomich, Howard Twining, and Henry G. Weston, Jr.

The testis cycle was established for 120 males collected within three miles of the Hastings Reservation between January 5, 1955, and May 10, 1956. Testes were removed in the field within ten minutes after death, measured to the nearest 0.5 mm., and fixed in Bouin's fluid. They were subsequently prepared by the paraffin technique, sectioned at 7.5 or 8 microns, and stained either with Galigher's or Harris' hematoxylin and eosin. The reproductive cycle was established for 68 females collected during the same period. Each was autopsied in the field, and the ovary and oviduct were examined macroscopically. When the ovary showed any sign of activity, the largest follicle was measured to the nearest 0.25 mm. The presence or absence of an incubation patch was also noted.

To indicate the various stages of activity of the testis, the seven stages outlined by Blanchard and Erickson (1949:266) were used, with the exception that their stages 1 and 2 are considered as a single stage 1–2. The stages are as follows:

Stage 1–2. Resting spermatogonia only.
Stage 3. Increase in spermatogonia. First primary spermatocytes.
Stage 4. First primary spermatocytes in synapsis.
Stage 5. Predominance of primary spermatocytes in synapsis.
Stage 6. First spermatids.
Stage 7. Breeding.

To assess the reproductive state of females, the four stages of ovarian development described by McCabe (1943:551–2) were used, and incubation patches, when present, were classified according to the four stages described by Bailey (1952:125–7). In addi-

tion, a subjective estimate of the development of the oviduct was made. The four stages of reproductive development are as follows:

Inactive. Ovary uniform, non-granular. Oviduct thread-like and barely visible. Incubation patch absent.

Low development. Ovary rather granular, some oöcytes definitely enlarged. Oviduct ranges from minimum size to moderately enlarged. Incubation patch absent.

Breeding. Oöcytes moderately enlarged to discharged. Oviduct greatly enlarged. Incubation patch present, stage I (defeathered), stage II (vascularized), or stage III (edematous). Any female with a stage I incubation patch was termed "breeding," as it was assumed that such a female would have laid even though it had not done so at the time of collection. Recent laying could be established by the presence of ruptured follicles.

Postbreeding. The ovary is markedly granular or "gravelly" (McCabe, 1943), with many hard, degenerating oöcytes which are mostly yellow or cream-colored. The oviduct is small. A stage IV (recovery) incubation patch is present.

The age of each individual was determined on the basis of the criteria outlined by Davis (1957). Two age groups are recognized in this study. They are first-year, including those birds taken between the end of the postjuvenal molt and the beginning of the first postnuptial molt, and adult, indicating those birds which have completed at least one postnuptial molt.

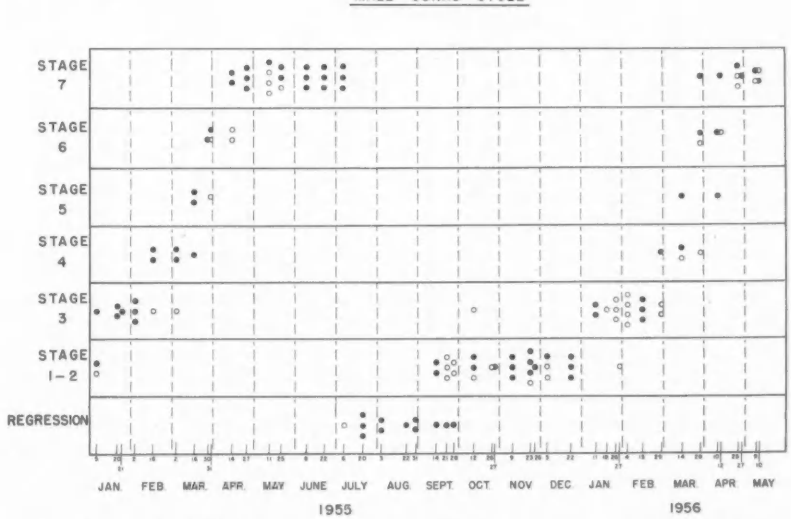

Fig. 1. Testis cycle of *Pipilo erythrophthalmus* based on specimens collected near the Hastings Reservation between January 5, 1955, and May 10, 1956. Dots represent adults; circles represent first-year birds.

THE GONAD CYCLES

The testis cycle.—The male gonad cycle for the period from January 5, 1955, to May 10, 1956, is presented graphically in figure 1. Spermatogenic activity starts in early January. Breeding condition may be reached as early as March 28, but most males reach this stage at about the middle of April. Regression from breeding condition may start as early as July 6 in some individuals, and it is apparently under way in all males by

July 20. Regression is complete in most males by the middle of September, although one collected on September 28 was still in the terminal stages of regression. Through the fall and early winter the testes of most males are in an inactive condition, although in the testes of some individuals there is a slight proliferation of spermatogonia. During this period, the testes of only one male, a first-year bird collected on October 12, reached stage 3. Thus, in the fall, there is no recrudescence of spermatogenesis in adults or initiation of spermatogenic activity in the great majority of first-year males.

Table 1

Stages of Gonadal Development Attained by First-year and Adult Males Collected on the Same Day

1955			1956		
Date	Age	Stage	Date	Age	Stage
Jan. 5	Immature	1–2	Feb. 29	Immature	3
	Adult	1–2		Immature	3
	Adult	3		Adult	4
Feb. 16	Immature	3	March 14	Immature	4
	Adult	4		Adult	4
	Adult	4		Adult	5
March 2	Immature	3	March 28	Immature	4
	Adult	4		Immature	6
	Adult	4		Adult	6
March 31	Immature	5		Adult	7
	Immature	6	April 10	Adult	5
	Adult	6		Adult	6
April 14	Immature	6	April 12	Immature	6
	Immature	6		Adult	7
	Adult	7			
	Adult	7			
July 6	Immature	Regression			
	Adult	7			
	Adult	7			
	Adult	7			

Throughout the period of spermatogenesis there is a definite tendency for adults to precede first-year birds in the attainment of stages 4 to 7. This can be seen in table 1. In only one case does any first-year bird precede any adult. During the period from April 10 to 12, three adults were in stages 5, 6, and 7. A single immature was in stage 6, at the average stage of the three adults and more advanced than one of them. It is apparent that on any given date most adults have reached a more advanced stage than have first-year birds. As regards the onset of regression, the material is inadequate to determine any differential between adults and first-year males. On July 6, three adults were still in stage 7, but the testes of a first-year male were regressing. On July 20, one adult was in the earliest stages of regression. Bundles of sperm were still present, but the average number of sperm per bundle was lower than in breeding testes. The left and right testes measured 13×7 and 11×8 mm., respectively. The testes of two other adults taken on this date were well into regression, with no mature sperm present. The left testes of these males measured 4×2 and 8×5 mm.; the right testes measured 2.5×1.5 and 6×6 mm.

The situation is suggestive of that described for the Redwinged Blackbird (*Agelaius phoeniceus*) by Wright and Wright (1944:51), in which development of the testes in adults preceded that in first-year birds by about three weeks. The differential between age groups is not as well documented in the towhee because of the small samples of first-

year birds, these being indistinguishable from adults in the field. Nevertheless, the general schedule of spermatogenic activity in the towhee suggests that of *Agelaius* and contrasts with that described for the White-crowned Sparrow (*Zonotrichia leucophrys*). Regarding *Z. l. nuttalli*, Blanchard (1941:57) stated that "immature birds stay in the winter condition [stage 1] longer on the average than do the adults," but she included them in her graphs of behavior and development. Of *Z. l. gambelii*, Blanchard and Erickson (1949:266) stated that the testis cycle of first-year birds was identical with that in adults except for slight differences in testis volume, and they found "no evidence to suggest that immatures were consistently behind the adults in the achievement of comparable histologic stages . . . ." In this regard the testis cycle of the Rufous-sided Towhee more closely resembles the cycle of the icterid *Agelaius phoeniceus* than that of its fellow emberizine, *Zonotrichia leucophrys*.

Table 2

Lengths of Testes in Millimeters at Different Stages of Gonadal Development

Stage	Age	Mean Left testis	Range Left testis	Mean Right testis	Range Right testis
1–2	Adult	1.92 (12)	1.5–2.0	1.65 (10)	1.5–2.0
	Immature	1.06 (9)	1.0–1.5	0.94 (9)	0.5–1.0
3	Adult	1.82 (11)	1.5–2.0	1.64 (7)	1.0–2.0
	Immature	1.42 (12)	1.0–2.0	1.12 (13)	1.0–1.5
4	Adult	3.19 (8)	2.5–4.0	2.57 (7)	2.0–3.0
	Immature	2.50 (2)	2.0–3.0	1.75 (2)	1.5–2.0
5	Adult	4.33 (3)	3.0–5.0	4.12 (4)	3.0–5.0
	Immature	4.00 (1)	.....	3.50 (1)	.....
6	Adult	7.17 (3)	5.0–8.5	6.50 (3)	5.0–7.5
	Immature	6.67 (3)	5.5–7.5	5.83 (3)	5.0–6.5
7	Adult	11.95 (19)	10.5–13.0	10.41 (16)	8.0–12.0
	Immature	10.06 (8)	9.0–11.5	8.43 (7)	7.0–10.0

Testis size.—For any given stage, adults tended to have greater testis lengths than those of first-year birds (table 2). This parallels the situation described for *Agelaius phoeniceus* and *Zonotrichia leucophrys*. Reference to table 2 will show that simple measurements of greatest length will not differentiate between adult testes in stages 1–2 and 3, the mean lengths for these stages being nearly equal. The means for the testes of first-year birds in these stages are farther apart, but there is still considerable overlap in testis length between the two stages. Adult testes in stage 4 are considerably larger than those in stage 3. From the small samples available, it would appear that any adult with a left or right testis 2.5 mm. long is in stage 4. From stage 4 through stage 7, testis length in both age groups shows a steady increase. The testes of adults average slightly longer than those of first-year birds throughout, and the left testis always averages longer than the right, the usual situation in birds. Any adult with a left testis 10.5 mm. or longer, and a right testis 8.0 mm. or longer, is in full breeding condition. The corresponding figures for first-year birds are 9.0 and 7.0 mm. Three general groups can be safely differentiated on the basis of testis length: stage 1–2 and 3; stages 4 to 6; and stage 7.

Intertubular tissue.—In order to estimate the relative abundance of Leydig cells in the intertubular tissue, the following classes of abundance were used:

Rare. 1–3 Leydig cells per section.
Occasional. 5–10 cells per section.
Fairly common. Up to 3 cells per 500 × field.
Common. 5–15 cells per 500 × field.
Very common. 20 or more cells per 500 × field.

In 35 males collected between August 3 and December 22, what appeared to be fully developed Leydig cells were rare in the testes of 12 birds (August 3 [2], September 21 [2], September 28, October 12, November 9 [2], November 23, December 5, and December 22 [2]). Such cells were occasional in the testes of five birds (September 28, October 12 [2], November 26, and December 22). In the testes of the remaining 18 birds, small numbers of partly enlarged and somewhat rounded cells were found, apparently similar to those described by Miller (1954:18) for the Golden-crowned Sparrow (*Zonotrichia atricapilla*) and considered by him to be possibly developing Leydig cells. In the material at hand, it was not possible to differentiate consistently between spermatogenically inactive testes which lacked or possessed Leydig cells (stages 1 and 2 of Blanchard and Erickson, 1949).

In January and early February there was a definite increase in the numbers of Leydig cells in both first-year and adult birds. Of 18 males collected between January 5 and February 4, Leydig cells were fairly common in the testes of 15, occasional in one, and rare in one; they were common in the testes of a first-year male collected on February 4. Of five males collected on February 15 and 16, Leydig cells were common in the testes of four, and fairly common in the fifth. The testes of a sixth male contained heavy deposits of fixative which precluded making an accurate count. Leydig cells were common in the testes of three birds collected on February 29. Thus, a definite further increase in the numbers of Leydig cells occurred between February 4 and 15 and continued at least until mid-March.

The female cycle.—The factors influencing the ovarian cycles of passerines are poorly understood. Some evidence from other studies suggests that psychic factors may be of importance in bringing about progression of the cycle; such factors might be the presence of an adequate nest site and food supply and the presence of a male (see Burger, 1949:225–226; Marshall, 1951:253–255). In collecting the females used in this study, it was realized that the collecting of a male might have a deterrent effect on the progression of the ovarian cycle of his mate. Therefore, an effort was made to avoid collecting females on successive trips at localities at which males had been taken previously. In addition, records were kept in the field as to whether each female collected was or was not paired. Females were considered paired if accompanied by a male, if a male sang or foraged nearby, or if a male and female responded in company to the squeaks and imitated Pygmy Owl calls used to draw towhees from brush to exposed perches. Of the 29 females collected in 1955 and 1956 from March, when ovarian development was first visible macroscopically, through July, when breeding had ceased, 18 were paired. There is no proof that the other 11 females were or were not mated, as very little time was spent observing the birds before they were collected. All females collected in the critical period from mid-April to mid-May were paired (see fig. 2), and it is felt that the collecting of males did not interfere with the cycles of the females used in this study. It is of interest that in the six pairs of which both members were collected, both male and female were in the same age group. Three adult females were paired with three adult males, and three first-year females were paired with three first-year males.

The female reproductive cycle is presented graphically in figure 2. In 1955, the cycle was more uniform than that of 1956, in that after the first adult in a stage of low development had been collected, on March 2, all females collected subsequently were in this stage of reproductive activity until the onset of the breeding season. In 1956, a first-year female collected on February 29 was still in the inactive stage. The first female collected in a stage of low development was taken on March 14, but two others taken on the same day were inactive. All three were first-year birds. On March 28, an adult

had an enlarged oviduct, and many oöcytes had enlarged to 1 mm., but a first-year bird taken on the same day was still inactive. It may be that first-year females leave the inactive stage more slowly than adults, and that the discrepancy between the cycles of 1955 and 1956 was caused by the preponderance of first-year females collected in 1956. It will be noted (fig. 1) that in the males, also, the samples collected in the spring of 1956 contained a much higher proportion of first-year birds than did the samples collected in the spring of 1955. This was to be expected, since the same collecting areas were used in both years. Apparently, in 1955, most of the established adults were shot off and replaced by birds of the year, and a shift from a preponderantly adult to a preponderantly first-year population took place. In attempting to equate the cycles for 1955 and 1956, only females of the same age should be compared. In 1955, the first immature showing low ovarian development was collected on March 16, and in 1956, on March 14. The first breeding adult was collected on April 27 in both years. The small samples indicate that the timing of the cycles was similar in 1955 and 1956.

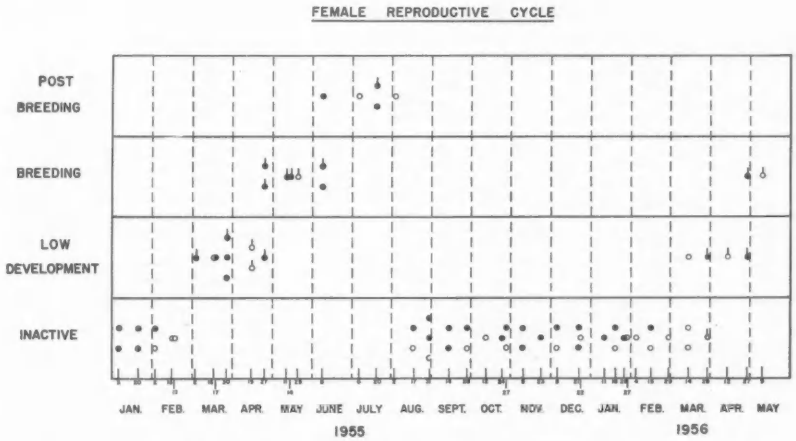

Fig. 2. Reproductive cycle of female *Pipilo erythrophthalmus* based on specimens collected near the Hastings Reservation between January 5, 1955, and May 9, 1956. Dots represent adults; circles represent first-year birds. Symbols with vertical line above represent paired individuals.

In 1955, the first males in breeding condition were collected on April 14, and all adult males collected after this date were in breeding condition. The first breeding females were collected on April 27. Thus, in 1955, adult males reached breeding condition about two weeks before the adult females. In 1956, the first adult male in stage 7 was collected on March 28. However, April 12 was the date on and after which all adult males collected were in breeding condition. The first breeding adult female was collected in 1956 on April 27. Again, the males preceded the females by about two weeks. The discrepancy between the males and females was thus noticeably shorter than that reported for the House Sparrow (*Passer domesticus*) in southern California (about four weeks; Davis and Davis, 1954:343) and for the Song Sparrow (*Passerella melodia*) in the San Francisco Bay region (about four to six weeks; Johnston, 1956:32).

SINGING BEHAVIOR

First and last song dates.—Singing is first heard in most years between the middle of January and the first week in February. Records at the Hastings Reservation show that first singing was heard on the following dates: February 6, 1938; January 18, 1939; February 2, 1940; February 1, 1942; January 29, 1943; January 17, 1951; January 15, 1954; January 31, 1955; February 1, 1956; and February 15, 1957. In 1954, singing was widespread in the general population by February 17, when eight males were heard during one morning's observation. On February 16, 1955, at least ten males were heard during a full day's observation. Thus, in 1954, 34 days elapsed between the first record of singing and the date on which singing was heard commonly; in 1955, this period was 17 days. However, the dates in each year on which song was first considered as being widespread are only one day apart.

Last summer song was heard in 1954 on August 3 (one bird, two minutes); in 1955, on August 7 (one bird, one trill); in 1956, on August 2 (two birds; one sang an awakening song of two trills); and in 1957, on August 4 (one bird, 18 trills). Brief singing heard on August 12, 1956 (one trill), and on August 10, 1957 (one bird, two trills), was not considered as pertaining to regular late summer singing, as these were isolated records preceded by an absence of song of ten and six days, respectively.

In September and October, brief periods of song were occasionally heard, indicative of a slight recrudescence of singing involving only a small percentage of the total male population. On September 14 and 15, 1942, single males in different areas were heard singing. In 1953, song was heard on September 22 (one bird, for about one minute), 23 (one bird, four trills), and October 10 (one bird, three trills); in 1954, on September 4 (one bird, two trills), 20 (one bird, for about one minute), 28 (one bird, for two minutes), and October 4 (two birds; one sang "several" trills, and the other sang four trills); in 1955, on September 14 (one bird, two trills), 17 (two birds; one sang for about two minutes, and the other sang two trills), 18 (one bird, three trills), 24 (one bird, four trills), October 2 (one bird, five trills), 11 (one bird, 15 trills), and 15 (one bird, one trill); in 1956 on September 15 (one bird, four trills) and 29 (one bird, seven trills); and in 1957 on September 8 (one bird, two trills) and October 13 (one bird, four trills). In 1955, one of the birds heard on September 17, and males heard on September 18 and 24, and on October 2 and 11, sang in the same general area, and these records may all apply to the same individual. Counting each record as applying to a different male, only twenty-two were heard in six years. On the 15 birds for which trills were counted, the average was only 4.1 trills per individual. Of the four birds for which the amount of singing was expressed in minutes, the average song period was only 1.5 minutes. Autumn song, although of regular occurrence, is thus brief and it is limited to only a few individuals.

Song form.—The song of the Rufous-sided Towhee is usually a simple trill of 0.4 to 0.6 seconds duration, sometimes preceded by a sharp *chip* note. Five tests on the range of audibility of birds singing from trees at the edge of an open field showed that the mean distance at which trills could be heard by the human ear was 750 feet (range, 700 to 800 feet). The trills themselves, however, may show considerable variation, not only from bird to bird, but within the song repertoire of the individual. Most published descriptions of the song of the Rufous-sided Towhee do not indicate its true variability. For example, Peterson (1941:183) characterizes it as a "drawn-out, buzzy trill, *chweeeeeee*," or in some races as a *chup chup chup zeeeeeeeeee*. Grinnell and Storer (1924:478) render the song as *tu-wheeze*. Hoffmann (1927:313) describes it as a "*bree*, long drawn out." Dawson (1923:395–6) described variation in towhee songs and listed

several phonetic versions of songs which he had heard. He felt that this variation was geographic, and indeed, this may be true; yet, he gave no indication of the wide variation of song in the individual or within a limited population.

There are five basic types of song in the repertoire of most individuals treated in this study. These are as follows:

1. The basic trill. This is a simple, flat trill, without metallic overtones, and it is the most frequently heard song in the population treated here.

2. The chip trill. This song consists of a sharp, clear *chip* followed by a trill. Very rarely, an individual may precede a trill by two *chip* notes. Nearly always, the *chip* is followed by a basic trill.

3. The dry trill. This is a very hard, flat trill, which has the quality of the buzzing of an insect.

4. The metallic trill. This is a simple trill with definitely metallic or "tinny" overtones.

5. The warbled trill. This is a musical trill in which the individual notes are rather widely separated and easily distinguishable. It is the only trill that may be termed "musical" by human standards. It represents the widest departure from the basic trill.

Since most songs are basic trills, and since basic and chip trills make up nearly all song early and late in the season, they are considered the fundamental types of trill in the repertoire.

In addition to the usual complement of five types of trill, males often sing intermediates between two types, such as basic x metallic, basic x dry, and so forth. Since there is considerable individual variation in the basic trill, a great deal of listening to a given male is required in order to differentiate his trill types and the intermediates between them. The most valuable information is derived from the shifts from one type to another that often occur within a period of steady singing.

The complexity of singing is further increased by the tendency of some individuals to alternate two types of trill, singing first one, then the other, in perfect sequence, for minutes at a time. Such periods of alternation, interspersed with periods of singing a single type of trill, are restricted in most instances to the first 30 to 45 minutes of early morning song, although occasionally alternation may be heard at other times of the day. Such alternation usually involves basic trills and one of the other four types. One male, out of sight, alternated full-strength basic trills with half-strength basic trills. Since males invariably sing while facing straight ahead, it does not seem likely that this male was alternately shifting position to face toward, then away from the observer.

A number of aberrant, highly distinctive trills were heard in the course of the study. Some of these were variations of one or more of the usual types, while others were completely unrelated to any of the usual types and were not recognizable modifications of any of them. Such aberrant trills were important mainly in that they appeared to be characteristic of particular individuals singing in the same areas on successive years, and they served to identify particular males from one year to another.

The amount of singing devoted to each of the five usual types of trill can vary from individual to individual, or within the singing of a given individual from day to day. In 2986 minutes of the singing of a nesting male during 13 days of observation in 1954, there was considerable daily variation in the amount of singing time devoted to the different trills. In this period, an average of 47.7 per cent of this male's daily song output was composed of the basic trill (range, 28.2 to 72.4 per cent), and 9.5 per cent was composed of chip trills (range, 2.8 to 24.3 per cent). These two types of trill, considered the most generalized in the repertoire, accounted for an average of 57.3 per cent of the

bird's singing (range, 47.8 to 81.6 per cent), and on only one day did the combined percentage fall below 50 per cent. The two days on which the most chip-trilling was done (21.6 and 24.3 per cent) were those days on which the least basic trilling was done (33.6 and 28.2 per cent). In 2186 minutes of singing by another nesting male the following year, possibly the same bird heard in 1954, an average of 45.8 per cent of song was basic trilling (range, 33.2 to 62.2 per cent), and 17.9 per cent was chip-trilling (range, 2.6 to 45.4 per cent). These two types combined accounted for an average of 63.7 per cent of all song (range, 48.6 to 82.8 per cent), and on only one day did the combined average fall below 50 per cent. In 557 minutes of singing by an unmated male, 62.8 per cent was composed of basic trills and 26.9 per cent was composed of chip trills for a combined average of 89.7 per cent.

The particular type of trill used by a singing male does not depend on the trill types used by other males within earshot. At times, two males singing near each other might sing the same type of trill, but when one changed type, the other did not do so. Nor did singing males shift trill types to match the songs of other males starting to sing near them. Singing males will often shift trill types without any apparent reason. Such shifts may occur within one period of steady singing; at other times a bird which has used one type of trill through several singing periods separated by intervals of several minutes may resume singing after such an interval with another type of trill. Usually the change from one type of trill to another within a single period of steady singing is abrupt, but occasionally a gradual transition may be made. A few examples of the latter will suffice. A male singing basic trills during several song periods from 7:52 to 9:23 a.m. resumed singing basics at 9:28.5 a.m. At 9:31.5 he twice sang chip trills after every third basic, then alternated basic and chip trills three times (six songs), after which he sang chip trills steadily. Another male sang warbled trills during several song periods from 9:56 to 10:46 a.m. At 10:46 he alternated warbled and chip trills three times (six songs) and then sang chip trills during several periods until 11:34 a.m. Another male made a transition from steady basic trilling to steady chip-trilling as follows: basic, chip, basic, chip, basic, chip, basic, chip, chip, chip, basic, followed by steady chip trills.

The reasons for shifts in trill types are obscure. Frequently, as I approached a singing male, the bird would become silent when I came close to him and would then resume with another type of trill after I had passed. This happened so often that it seemed as though disturbance to the singer may be one cause of shifting song types. In most instances, no disturbance was evident to me when a male, watched from a distance, shifted trill types, although the singer may have seen sources of disturbance of which I was unaware. However, it does not seem likely that the gradual transitions from one trill type to another, described previously, resulted from disturbance. Hartshorne (1956) suggested that there is a "monotony-threshold" in the singing of most passerines, and that when singing is nearly continuous, the singer will vary his performance to avoid monotony. However, he defines discontinuous singing as that in which the actual song occupies at most only 30 per cent of the total performance time, with a pause between songs two and one-third times the duration of the song itself (70 per cent of performance time). Since individual songs of the Rufous-sided Towhee last only 0.6 seconds, at most, with an average pause between songs of about six seconds, the song itself occupies only 9.1 per cent of the total performance time, and singing is thus highly discontinuous. Such singing, according to Hartshorne, would not require variability to avoid monotony, and the reasons for the frequent shifts in song type are not clear. No male, at any time of year, was ever heard to run through his entire repertoire of songs before repeating a trill type given previously.

As the song season progresses, singing becomes more complex as additional trill

types are included in the repertoire. All trills heard in January and early February were either basic or chip trills. In 1955, the first dry trill was heard on February 14, the first warbled trill on February 24, and the first metallic trill on March 8. In 1956, the first warbled trill was heard on February 13, the first dry trill on March 20, and the first metallic trill on March 24. In 1955, the first alternation of trill types was heard on April 5, and in 1956, on April 19. Conversely, toward the end of the song season and during the period of fall singing, the performance becomes less complex. Of 51 periods of singing heard from July 20 through October 13, 48 were composed of either basic or chip trills, one was composed of metallic trills, one was composed of warbled trills, and one consisted of alternating metallic and warbled trills (four songs). In addition to being almost entirely limited to basic and chip trills, the singing heard in mid-winter, late summer, and fall is often of low volume, and the individual trills are often abrupt and not of full length. During the latter part of July, and in September, very aberrant trills were sometimes heard. On July 27, 1956, an awakening song consisted of five very abrupt, whistled *pweet* notes, and on July 31, the same bird sang an awakening song consisting of whistled *wheep* and *wheet-wheet* notes. On September 4, 1954, a male gave a loud, harsh note, followed 10 seconds later by a basic trill. On September 17, 1955, a male gave three or four very peculiar *tseep* notes, then an aberrant trill, indescribable, and then he sang basic trills. On September 29, 1956, a bird sang six basic trills and then an aberrant *che-che-che*. It may be that such performances represent singing by birds of the year.

Threat song.—Although some suggestion of threat is implied in most, if not all, of the singing of the Rufous-sided Towhee, the term "threat song" is reserved for the rapid, subdued singing of males in close proximity, often resulting in combat. Such song is characterized by very low volume, and it is sometimes barely audible. It is steady and the rhythm is very rapid, with intervals between songs of no more than one second. Often, the trills are abrupt and incomplete. When two males are near each other both may sing in this fashion, and the trills come so rapidly that at times the singing seems nearly continuous. Males may sing in this fashion for several minutes before a clash results, or a male may sing threat songs on his way to attack another male, or such singing may be heard during a chase. A persistent attack made by one male against another lasted for 35 minutes, with the pursuing male singing very softly much of the time. The pursued bird sang infrequently, possibly because he carried a dead oak leaf in his bill during at least the last 26 minutes of the running combat, still retaining it when he finally flew off. Howard (1952:77) has described the habit of males carrying dead oak leaves during territorial disputes of the Blackbird (*Turdus merula*). Not all attacks are accompanied by typical threat song. They may be completely silent, or they may be accompanied by singing of normal strength and rhythm.

Nice (1937:57) describes a similar type of low, rapid singing in the Song Sparrow (*Passerella melodia*); in that species it occurs in males newly arrived on the breeding grounds when they attempt to take up territories near already established birds. She also notes that a bird singing in this fashion will frequently hold one wing straight up in the air and flutter it. This habit has also been noted in the Rufous-sided Towhee at the Hastings Reservation, but it apparently occurs in males which are already established on territory. The six instances of wing-raising display noted in towhees occurred on April 24, May 8 (2), May 21, May 30, and July 15. Since nesting usually starts during the last week in April, all these instances fall within or beyond the nesting period. Linsdale (MS) noted two displays; the pursuing male displayed in one instance, and the pursued male in the other. Three displays were given by a color-banded male known to be mated. In one case, this male displayed when another male started to sing nearby;

he then flew closer to the singing male and sang loudly and steadily in return. This same male started to display on July 15 when a full-grown juvenile flew in and landed near him, but he checked his movement before his wing was fully extended. Once he displayed when no other towhee was evident to me, but a short time later he was fighting with and driving off another male. In the sixth instance an unbanded male, singing, suddenly started to move through nearby brush, pausing several times to raise and flutter one wing. I saw no other towhee, but the male under observation traveled about 30 feet through the brush before returning to his original station and resuming his singing. Low, rapid, aggressive singing and the wing-raising display are common to the Song Sparrow and the Rufous-sided Towhee, but they seem to occur under different circumstances in the two species.

A peculiar, rapid, musical twitter, rising and falling, was given by a nesting male chasing another male on four separate occasions. I had heard this twitter previously from other fighting males, but it was so unlike any other performance given by a Rufous-sided Towhee that I did not associate it at the time with that species. Almost a year later another male, color-banded, gave the same twitter as he pursued a male invading his territory. Although it is not heard frequently, this vocalization is apparently given during combat by a small proportion of the male population.

Posture.—In the normal singing posture, the tail may be slightly cocked above the dorsum or held in line with it. The same individual may sing with the tail in either position. The wings are usually held against the sides of the body although a few males sang with them folded over the dorsum. At each song the bill is opened, the tail is depressed slightly, and the head is thrown back. Some males sang muted trills while holding insects in their bills, which were thus not opened to the full extent at each song. Males invariably face forward while actually singing, and the eyes are kept open. Towhees singing from the ground while foraging always look straight ahead to sing, interrupting their foraging to do so. This is probably because the songs of the Rufous-sided Towhee are so brief. The Winter Wren (*Troglodytes troglodytes*), with a song lasting five or six seconds, turns its head from side to side while singing (Armstrong, 1955:58), as do the Grasshopper Warbler (*Locustella naevia naevia*), with a trill sometimes sustained for as long as two minutes, and the Nightjar (*Caprimulgus europaeus europaeus*), with a sustained trill sometimes continuing for five minutes (Witherby, Jourdain, Ticehurst, and Tucker, 1948).

Song perches.—Song perches of the Rufous-sided Towhee are highly variable and males may sing from the ground while foraging or from as high as 50 feet up in tall trees. By far the greatest number of singing perches noted were in trees, especially in live and valley oaks, but to some extent in willows and sycamores. Shrubs of various kinds may be used, especially coffeeberry, with some records for elderberry, coast ceanothus, poison oak, and chamise. Of 1579 song perches recorded, 1239 were in trees, 196 were in shrubs or brush, 133 were on the ground while foraging, and 11 were on the ground, not foraging. Towhees may sing from exposed perches, such as bare limbs or the tops of trees or shrubs, but usually they sing from leafy cover where they are at least partly concealed. Intermittent singing from the ground while foraging was noted in all months from February to August. Much of the early song noted in February was intermittent and came from the ground. Although the singer was not always seen, sounds of foraging between songs indicated that he was foraging at the time. Song heard early in the season and in the fall tended to be delivered from somewhat lower perches than that heard from March through July. Not including song from the ground, the song perches of four males heard in January averaged 10.75 feet above ground, and those of six males heard from September through November averaged 13 feet up. The average elevations of singing

Table 3

Height in Feet of Singing Perches of a Nesting Male During Incubation Period

Date	Number	Height
May 6	9	25.0
May 8	9	25.4
May 10	8	23.2
May 11	17	21.1
May 12	11	21.6
May 13	35	19.2
May 14	26	17.4
May 15	25	15.9

Table 4

Height in Feet of Singing Perches of an Unmated Male

Date	Number	Mean height	Range
Apr. 9, 1956	11	23.3	0–45
Apr. 11, 1955	15	25.1	0–40
May 17, 1955	76	21.9	0–50
June 21, 1955	41	17.7	0–40

males recorded on 511 occasions from March through July ranged from 15.8 feet in June to 23.3 feet in April. The status of a given male during the breeding season appears to have some effect on the average height above the ground from which he sings. It will be seen that the mate of an incubating female sang from increasingly lower elevations as the incubation period progressed, with an especially pronounced change during the three days prior to hatching (table 3). The unmated male for which data are given (table 4) appeared to sing from increasingly lower elevations as the breeding season progressed. Further, in the nesting male, singing from the ground while foraging increased noticeably during the last four days of the eight days after hatching on which observations were made. The number of song periods from the ground per hour during the first four days after hatching were 0.49, 0.00, 0.21, and 0.09, but during the last four days the frequency increased regularly as follows: 0.54, 0.67, 1.33, and 1.70. Since the number of trips which he made per hour to the nest with food for the young varied only slightly during the eight days of observation, the increased amount of singing from the ground did not result from more frequent foraging periods, but it may have resulted from a switch from foliage foraging to ground foraging.

Intervals between songs.—The intervals between songs, when singing is steady, are surprisingly regular, and they vary within narrow limits. Some individuals were heard singing for several minutes at a time with perfectly regular intervals between songs, indicating a well-marked, inherent sense of timing in this species. Singing, while fairly steady, may be very irregular when it is carried on by birds foraging or preening between songs. However, even when engaged in other activities between songs, a male may maintain perfectly regular intervals. One male, watched for five minutes, dressed his back and breast feathers between songs, but he faced ahead and sang at perfectly regular intervals of four seconds. The following sequence of the numbers of songs per minute sung by one male will indicate the regularity of singing over a period of time. In seventeen minutes, he sang: 10, 11, 10, 9, 11, 11, 10, 10, 11, 10, 9, 10, 11, 8 (switched trill types midway in series), 10, 10, and 11 songs per minute. During one 32-minute period, he sang: 13, 13, 12, 13, 13, 13, 12, 12, 12, 13, 12, 12, 13, 12, 12, 12, 12, 11, 12, 8 (Scrub Jays, *Aphelocoma coerulescens,* screamed nearby during this series), 11, 11, 12, 11, 11,

10, 10, 9, 10, 8, 9, and 7 songs per minute. The definite decrease in singing during the last seven minutes may well have been due to fatigue, perhaps actual fatigue of the syringeal muscles.

Six hundred and thirty-eight timed intervals between songs ranged from one to 28 seconds in length. The mean was 6.2 seconds, and the median was five seconds. Of the 638, 505 (79.2 per cent) fell between four and eight seconds. There seemed to be little seasonal variation in interval length. Combining with the timed intervals figures derived from counts of number of songs per minute, and allowing 0.6 seconds for each song, the following monthly figures result: January, 20 trills, average interval, 5.8 seconds; February, 329 trills, 6.0 seconds; March, 535 trills, 5.8 seconds; April, 338 trills, 6.2 seconds; May, 962 trills, 6.8 seconds; and June, 835 trills, 5.4 seconds. The monthly variation falls well within the range of individual variation within any one month, and there are no pronounced shifts during the song season. Since the figures were derived from birds observed at all times of day, and since fatigue may possibly lengthen the intervals between songs, the monthly averages are surprisingly close.

Table 5

Singing of an Unmated Male for Eight Hours, May 24, 1956

Hour	Number of songs	Per cent of time singing	Average interval
8:15–9:15 a.m.	642	95.8	5.1
9:15–10:15	567	93.3	5.6
10:15–11:15	418	91.7	7.6
11:15–12:15 p.m.	412	88.3	7.4
2:25–3:25 p.m.	409	84.2	7.4
3:25–4:25	291	70.0	8.4
4:25–5:25	413	86.7	7.3
5:25–6:25	238	64.2	9.4
Totals	3390	84.3	7.3

On May 24, 1956, the singing of an unmated male was recorded for eight hours, from 8:15 a.m. until 12:15 p.m., and from 2:25 to 6:25 p.m. In this time he sang a total of 3390 trills. In the first four hours the percentage of each hour spent singing decreased steadily, as did the number of songs per hour, while the average interval between songs lengthened steadily (table 5). In the afternoon, singing decreased further in the first two hours, rose in the third hour, and fell off sharply in the last hour. There are three ways in which a bird can decrease the amount of singing that it may do at different times of the day. First, it may keep the intervals between songs the same but devote less time per hour to singing; second, it may devote the same amount of time per hour to song but lengthen the interval between songs; or third, it may use a combination of both methods. It will be seen that in the morning, the relative (not actual) percentages of singing time per hour decreased by only 7.8 per cent from the first hour to the last, but the average interval between songs increased by 45.1 per cent. This method of decreasing song output might be advantageous as it tends to spread singing over each hour fairly regularly, thereby avoiding lengthy periods of silence. Thus, the announcement of the presence of this male to other birds of either sex within earshot was rather steady, although the actual number of songs per hour declined noticeably. In the afternoon, the relative percentages of each hour spent singing, during the hours of most and least song, differed by 26 per cent, and the average interval between songs increased by 28.8 per cent, indicating that a combination of both methods was used. This resulted in a number

of lengthy periods of silence, as much as 14.5 minutes passing without any song, whereas the longest period of silence in the morning was only four minutes. The song output was less intense in the afternoon, not only in terms of the number of songs per hour and time spent singing, but in the less even distribution of song during the period of observation.

Amount of singing.—In January and February, when the song season begins, and again in the last half of July and in early August, when the season comes to an end, periods of singing are brief and they are separated by lengthy intervals. The same is true of singing heard in September and October.

Table 6

Numbers of Singing Males Counted on Early Morning Censuses, 1956

Date	Number of singing males	Date	Number of singing males
March 22	4	June 5	10
24	8	7	7
31	8	9	10
April 2	6	11	5
5	5	21	11
9	3	23	10
12	4	26	10
16	3	29	10
19	8	July 3	7
21	10	7	9
24	9	10	7
28	12	13	8
May 1	10	17	7
3	10	20	2
7	11	24	2
12	13	27	2
15	11	31	1
19	10	August 2	0
22	10	7	0
25	11	9	0
29	10	14	0
31	14	18	0

By the third week in March, most males are in full song, and on March 19, 1956, one male sang steadily for 44 minutes. In the first half of April, there is a decrease in singing. Some males which had been heard in certain places became silent at this time. This decrease is reflected in the results of a series of early morning censuses of singing males, starting on March 22, 1956 (table 6). By the third week in April, the numbers of males recorded on the censuses began to rise, and they reached a high level by April 28, at which time nesting activities got under way in most of the population.

During the breeding season, the amount of singing by a given individual seems to depend on whether or not he is mated, and if mated, on what his position in the nesting cycle may be.

The greatest amount of singing was done by an unmated male observed on May 24, 1956 (table 5). In eight hours, he sang 84.3 per cent of the time. Another unmated male, observed on April 11, 1955, sang 77.9 per cent of the time between 5:07 and 8:12 a.m. In this period only one other male sang, for two minutes, or 1.1 per cent of the time, and no song was heard from a nearby area in which two towhees, one a male and a second of undetermined sex, had been seen foraging 10 feet apart at 6:15 a.m. On May 17, 1955, the same unmated male was followed for 13 hours and 13 minutes. He sang 63

per cent of seven hours and 13 minutes in the morning, and 17 per cent of six hours in the afternoon. The latter figure is abnormally low, as the singing of this bird and birds of other species in the area was cut down by a strong wind which blew during much of the afternoon. During the morning, two other males sang persistently until 8:00 a.m., then sporadically until 9:00, and after this, one sang briefly a few times during the next three hours and ten minutes, when observations ended. On June 21, 1955, the same male was followed for eight hours and 35 minutes. Between 4:46 and 10:01 a.m., he sang 226.5 minutes (74.2 per cent of the time) and between 3:20 and 6:50 p.m., he sang 100.5 minutes (47.9 per cent). During the entire period of observation, he sang 63.5 per cent of the time. In the morning, three other males were heard. One sang 15 minutes (4.9 per cent), one sang 2.5 minutes (0.82 per cent), and the third sang 17.5 minutes (5.7 per cent). In the afternoon, two males sang, one for one minute (0.48 per cent) and one for 9.5 minutes (4.5 per cent). This unmated male was heard on many days, and at all times of day, when he was the only towhee singing within earshot.

On April 9, 1956, the same unmated male, identified by several aberrant types of trills first heard in 1955, was observed from 5:57 to 7:57 a.m.; during this time he sang 109 minutes (90.8 per cent). On April 19, he was noted accompanying a female. On the 19th, 21st, and 28th, he was observed for a total of 5 hours and 16 minutes, mainly in the early morning, and in this time he sang only 36 minutes (11.4 per cent). Unmated males apparently sing much more persistently than mated males.

The reactions of a male which had lost its mate seem to be somewhat different from those of a male unmated to begin with. On April 15, 1955, I collected two females from mated pairs occupying narrow, brushy draws about one-quarter of a mile apart. Be-

Table 7

Amount of Daily Singing by a Nesting Male, 1954

Date	Observation period (minutes)	Per cent of time singing
May 6	636	18.8
7	729	34.8
8	898	40.4
10	851	45.1
11	660	45.0
12	856	30.8
13	686	37.0
14	841	33.9
15	904	32.8
	Post-hatching	
17	861	21.5
18	687	15.0
19	867	16.3
20	698	13.3
21	854	15.6
22	873	34.8
24	855	37.9
25	669	50.1

tween 5:40 and 9:05 a.m., the only singing heard in the area was done by one male, for about two minutes, after I had shot his mate. On April 19, I returned to the same area. Between 7:50 and 8:30 a.m., "Dismated" male A sang 5.5 minutes and called 17 times. Between 8:49 and 9:17 a.m., at the other draw, no evidence of male B was noted. Upon my returning to male A, between 9:38 and 11:17 a.m., he sang 159 times and called 157 times. The only other towhee heard during this time called for a total of about four min-

utes. No other towhee song was heard. Avian activity was very low, and aside from the persistent calling and singing of a Bewick Wren (*Thryomanes bewickii*), only brief periods of singing and calling were heard from six other species. The great amount of calling in relation to singing, as opposed to the slight amount of calling done by unmated birds, suggested that this male had not only become more vocal after the death of his mate but that he was still searching for her four days later.

The singing of a nesting male observed between May 6 and 25, 1954, is presented in table 7. Hatching occurred on May 16. On May 6, this male sang only 18.8 per cent of the time. His singing steadily increased from May 7 through May 11, and then it fell off irregularly through May 15. Following hatching, his singing was noticeably depressed from May 17 through May 21, and it then rose steadily from May 22 to 25. The rise in the amount of singing seemed to correlate with decreased attendance at the nest by the female. From May 17 to 21, the female's attendance ranged from 63.1 to 88.6 per cent. On May 22, her attendance was 54.9 per cent, and on the 24th and 25th it was virtually nil.

Table 8

Amount of Daily Singing by a Nesting Male, 1955

Date	Observation period (minutes)	Per cent of time singing
May 26	587	38.5
28	493	50.9
30	552	30.8
June 1	265	42.6
2	451	45.5
4	567	62.8
6	542	62.9
	Post-hatching	
7	552	48.9
9	515	37.9

Seven days of the singing of a nesting male, between May 26 and June 9, 1955, are presented in table 8. In this nest, hatching occurred on June 7, and the nest was destroyed on June 10 or 11. The amount of time spent singing varied irregularly between May 26 and 30, rose sharply from June 1 to 6, fell 14 per cent on June 7, and fell another 11 per cent on June 9. On this last day, the male sang 24.8 per cent of the time between 5:05 and 9:00 a.m. At that time, a Scrub Jay flew to a point just above the nest and peered down at it. The male, on his way to the nest with food, flew off calling, but his mate dashed in and drove off the jay. At 9:01, the male began to sing, and until 11:40, when observations ended, he sang 66.7 per cent of the time, a figure comparable to that noted on June 4 and 6. When I resumed observations at 4:41 p.m., he sang 25.4 per cent of the next two hours, a figure comparable to that of the early morning. His overall performance for the day probably would have been about 25 per cent had it not been for the appearance of the jay and the male's greatly increased singing following the extreme danger to the nest.

Another male with young in the nest, observed on May 16, 17, and 19, 1956, for a combined total of 10 hours and 10 minutes, sang 17.4, 15.2, and 10.2 per cent of the time, respectively. There appears to be a definite tendency for males to sing more persistently during incubation than when young are in the nest. Nice (1943:119–120) found that this was true of male Song Sparrows.

The decrease in the number of singing males recorded in the censuses of June 7 and

11 may correlate with the presence of recently fledged young, although on June 9 the number heard was normally high (table 6). In early July there is a noticeable decrease in the numbers of males heard singing. Not only is this reflected in the census counts, but on some days no towhees were heard at all in areas where males had been heard to sing previously. On July 3, 1954, only one bird was heard in three hours and 45 minutes, and on July 9, none was heard in four hours and 35 minutes. On July 12, 1956, no towhee was heard in eight hours and eight minutes. During the first two weeks in July, most of the singing is confined to brief periods. By July 20, 1956, the census figures showed an abrupt decline, and on August 2 the last song of the summer was heard, but it was not in the census area. This situation contrasts sharply with that described by Marshall (1957:117) for Rufous-sided Towhees in the pine-oak woodland of southern Arizona and northern Sonora. He stated that in this area, "singing increases greatly in July and August as contrasted with April through June . . . ." although he noted that juveniles were abundant in late July and August, suggestive of nesting in June. If these birds did nest in June, then June and July would bear the same relation to the nesting season at the Hastings Reservation as July and August in the area studied by Marshall. No increase in singing was noted at the Reservation in June, and July was definitely a period of steadily decreasing song output.

Time of first vocalizing.—First vocalizing is here understood to mean either the first calling or singing of the day, whichever comes earlier for any particular individual. The Rufous-sided Towhee was one of the early species to become vocal in the area studied. On the average, from February 25 to October 3, this species was the seventh to call or sing. However, this rating is very general and serves merely to establish the Rufous-sided Towhee as a relatively early riser, and it should not be assumed that there was any rigid schedule in the order of first vocalizing in the species present. From mid-winter to early fall there were pronounced shifts in the time of first vocalizing of one species relative to another. The so-called "bird clock" was not operative over the entire period of time; rather, there was a series of "bird clocks," each evident during a particular segment of the entire study period.

In general, Violet-green Swallows (*Tachycineta thalassina*) and Western Bluebirds (*Sialia mexicana*) were by far the earliest birds heard, with the swallows usually the first species recorded. On those mornings when the bluebirds preceded the swallows, it seems likely that the latter had actually been active first but that the flock, twittering on the wing, came into earshot after the bluebirds had been heard. These observations agree with those of Weydemeyer (1934:251), who noted that Western Bluebirds were the second species to sing in the early morning at Fortine, Montana, being preceded only by Tree Swallows (*Iridoprocne bicolor*).

The next group of species to become vocal included the Western Flycatcher (*Empidonax difficilis*), Mourning Dove (*Zenaidura macroura*), Western Wood Pewee (*Contopus sordidulus*), California Quail (*Lophortyx californicus*), and Rufous-sided Towhee, more or less in that order, but all heard within the span of a few minutes. They were followed by the Brown Towhee (*Pipilo fuscus*) and the Bewick Wren. Scrub Jays, Wrentits (*Chamaea fasciata*), Plain Titmice (*Parus inornatus*), Hutton Vireos (*Vireo huttoni*), Red-shafted Flickers (*Colaptes cafer*), Nuttall Woodpeckers (*Dendrocopos nuttallii*), Anna Hummingbirds (*Calypte anna*), and the other species present had not ordinarily become vocal by the time I left the area.

Considering the middle group of five species, the exact order of awakening was seldom the same on any two consecutive mornings. In addition to the variation in the order of vocalizing from one morning to another, there were shifts in precedence that appeared to be seasonal. The relations of the Rufous-sided Towhee to the other four species and

to the Brown Towhee are shown in figure 3. From February 25 to May 15, this species preceded *Lophortyx* on every morning but one, when the two sounded off virtually simultaneously. On May 25 and 28 the two exchanged precedence on successive mornings of observation. From May 29 to June 29, *Lophortyx* was the earlier of the two, with only one exception. The quail in the area became silent after June 29. Mourning Doves were first heard in the study area on March 29, and from that date through July 8 the order of precedence was quite irregular. From July 9 until August 9, *Zenaidura* was without exception the earlier of the two to vocalize. After August 9, the doves stopped calling entirely, although their presence in the area was indicated by flight sounds up to October 3.

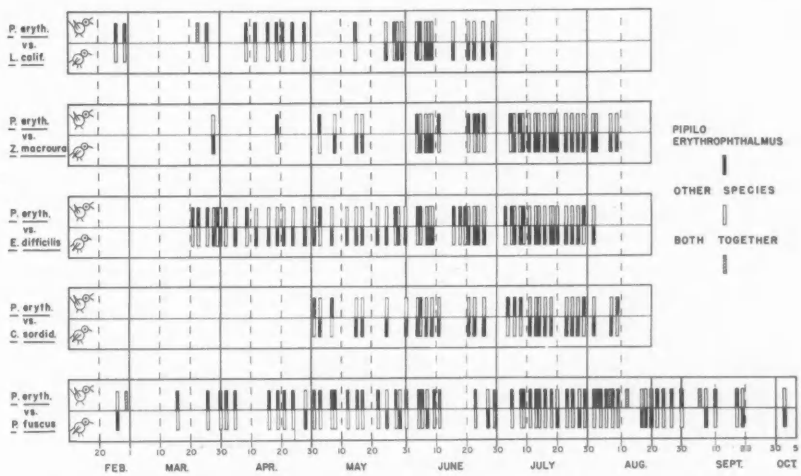

Fig. 3. Separate comparisons of the earliness of first vocalization of the day of *Pipilo erythrophthalmus* and the first vocalizations of: *Lophortyx californicus, Zenaidura macroura, Empidonax difficilis, Contopus sordidulus,* and *Pipilo fuscus.* In each daily comparison the earlier species is above the line. Records were made in 1955 and 1956 at the Hastings Reservation.

The relations of the towhee to the two species of tyrannids are rather similar. The Western Flycatcher was first heard in the study area on March 22, 11 days after its earliest recorded arrival at the Reservation (Linsdale, 1947:238). From March 22 to 27, the towhee preceded the flycatcher. From March 29 to April 9, there was a noticeable transition period, following which the flycatcher was the earlier, with relatively few exceptions, until it was last heard on August 1. The Western Wood Pewee was first heard on May 1, 16 days after its earliest recorded arrival at the Reservation (*loc. cit.*). Unlike the Western Flycatcher, which had arrived earlier in the study area, the pewee at once entered a transition period relative to the towhee, between May 1 and 7, and then became generally earlier until August 9, when it was last heard.

In relation to the Brown Towhee, the Rufous-sided Towhee was predominantly the earlier until August 12; from this date until October 3, the two species varied considerably in relation to each other, and on the 14 mornings of observation during this period they were exactly even in their order of first vocalizing.

As the Rufous-sided Towhee became relatively late in its vocalizing, other species

were recorded. Scrub Jays were heard only between July 25 and October 3, Wrentits between August 7 and September 2, and a Plain Titmouse on July 25 and 31.

From these observations it seems apparent that, with regard to the species in the study area, the bird clock operated in rather general fashion, and that a particular "clock" could apply only to a certain part of the study period.

Table 9

Relation of Time of Last Songs and Last Calls to Sunset, 1955–1956

		Minutes after sunset	
Date	Number	Mean	Range
	SONGS		
April 29–May 28	6	20.9	15–28
June 4–30	10	24.5	16–33
July 1–13	3	21.0	19–24
July 18–August 16	6	10.5	4–16
	CALLS		
April 29–May 28	7	23.1	16.5–29
June 4–July 13	3	25.7	24–28
July 18–August 16	13	12.4	2–24

Time of last vocalizing.—Between April 29 and August 16, 25 records were made of the time of the last song of the day, and 23 records were made of the time of the last call of the day. The relation of these songs and calls to sunset are shown in table 9. All of the records pertained to males, as judged by the fact that calling came from particular points at which song had been heard a short time previously, or that it came from a territory occupied by an unmated male. The only pronounced seasonal difference that appears is that the time of last vocalizing from July 18 on was noticeably earlier in relation to sunset. This shift occurred during the period when awakening song came markedly later in relation to both morning civil twilight and sunrise, and it suggests that after the middle of July, the daily activity period of the Rufous-sided Towhee becomes shorter in relation to both sunrise and sunset. Interspecific variation in the cessation of the day's activities relative to sunset appears to be high. For example, Nice (1943:106–107) found that there was little seasonal variation in the time of occurrence of the last note (either song or *tchunk*) of the Song Sparrow in relation to sunset from December to May, and again in October. Armstrong (1955:257, fig. 38), on the other hand, found considerable seasonal variation in the roosting times of the Winter Wren. Most of his records were based on a male. Roosting time came relatively earlier to sunset in May, June, and July. Since the dates of first eggs of the Winter Wren at Cambridge, England, where Armstrong's observations were made, ranged from April 15 to May 8 (*op. cit.*: 162), it would appear that the wren roosted relatively early in relation to sunset shortly after the onset of the breeding season, whereas the towhees, as judged from the time of last vocalization, did not cease daily activity at a relatively early time until after the breeding season was over. As is true of other passerines, towhees start their daily activities earlier in relation to sunrise than they cease these activities after sunset, as judged by the time of first and last song (fig. 4, table 9).

With regard to the time of last vocalization of the Rufous-sided Towhee in relation to other species, my records are too few to allow any detailed comparison. On the few occasions when detailed records were kept of the order of last vocalizing of all the species within earshot, those that were the latest to be heard included the California Quail,

Mourning Dove, Acorn Woodpecker (*Balanosphyra formicivora*), Western Flycatcher, Western Wood Pewee, Scrub Jay, Rufous-sided Towhee, and Brown Towhee. Since all but the jay and the woodpecker are among the first birds to vocalize in the morning, the few records tend to support the statement that "in general, the earliest risers are the latest to bed" (Nice, 1943:109).

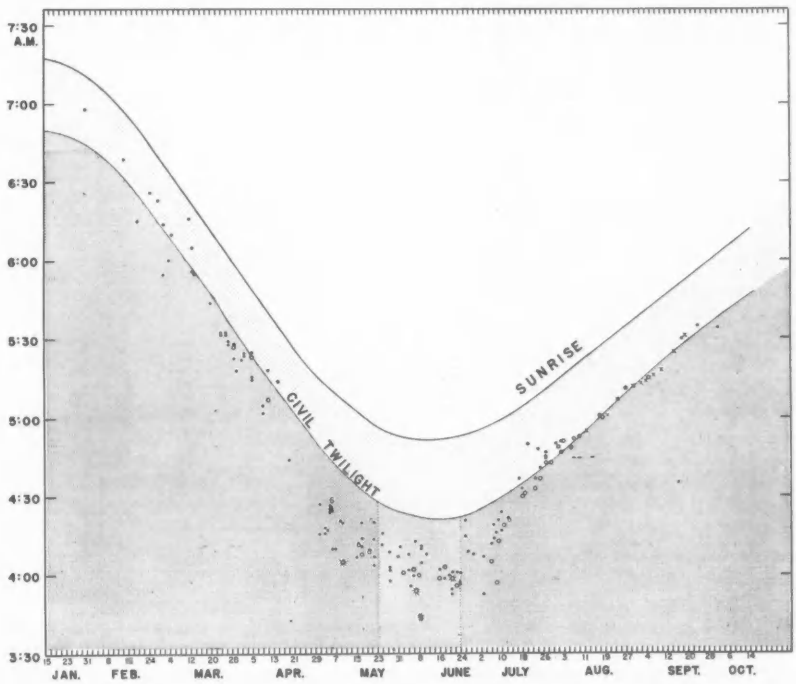

Fig. 4. Times of first songs of the day of *Pipilo erythrophthalmus* relative to morning civil twilight and sunrise on clear mornings only. Dots represent males of unknown status; circles represent a single unmated male. Rayed dots represent males already singing when observations began. The symbol X represents mornings in 1955 when observations were made but no song was heard; dashes represent similar data for 1956. Records were made in 1955 and 1956 at the Hastings Reservation.

Awakening song.—The term "awakening song" is something of a misnomer, as there is no evidence that a bird sings immediately upon awakening (Allard, 1930:455; Nice, 1943:99). Awakening song is used here as synonymous with first song (of the day), without any implication as to the actual awakening times of the individuals involved.

The awakening song of the Rufous-sided Towhee consists of a series of trills, coming between five minutes after and 25 minutes before the beginning of morning civil twilight. I have never heard night singing by this species, and there is no problem as to what constitutes true awakening song, as there is, for example, in the Song Sparrow (Nice,

1943:102). In January and February, uninterrupted periods of first singing averaged 5.33 minutes long for six males. On six mornings in May and June, nesting males sang awakening songs averaging 26.9 minutes long, interrupted only by occasional changes of singing perch. From July 24 to October 2, uninterrupted first singing was confined to very brief periods; in 12 instances it averaged 2.5 minutes long, and in ten instances it averaged 4.6 trills.

A total of 206 awakening songs was recorded between January 31 and October 2, 1954 to 1956. Of these, 152 occurred on clear mornings and 54 occurred on overcast mornings. The relation of songs heard on clear mornings to both morning civil twilight and sunrise is shown in figure 4. Between January and August, five general periods can be distinguished. In January and February, when song is becoming established in the male population, first song is relatively late. It comes noticeably earlier in March and in the first half of April, when mated males are seen on territory. From the middle of April, about two weeks before the onset of the breeding season, to the end of June, which is for most birds the end of the nesting season, awakening song is noticeably early. Of the nine songs recorded between April 16 and 30, eight were heard on overcast mornings, and they are not comparable to the other songs considered thus far. A single song heard on the clear morning of April 19 came 21 minutes before civil twilight, a figure somewhat below the average for May 1 to 15, but within the range of variation for the 18 songs recorded during that period. The eight songs recorded on overcast mornings averaged 13.9 minutes before civil twilight, considerably earlier than the average of 4.3 minutes for 10 songs occurring on overcast mornings between March 3 and April 12, and exactly the same as the average of seven songs recorded on overcast mornings from May 1 to 15. This suggests that the great increase in earliness, first evident on clear mornings from May 1 to 15, actually started about the middle of April.

	No. calls prior to first song	N	No. song without calling	No. minutes from 1st call to 1st song	N
MAR.- APRIL	23.2	8	0	4.34	14
MAY 1-15	1.75	4	3	0.40+	5
MAY 17-31	2.36	11	6	0.85+	13
JUNE 4-11	3.7	9	4	0.17+	9
JUNE 16-29	4.2	16	6	0.75+	16
JULY 3-13	6.2	13	5	1.1	12
JULY 17-31	35.4	9	0	5.6	13
AUG. 1-18	37.5	2	0	3.5	9

Fig. 5. Seasonal variation in numbers of calls preceding the first song of the day of *Pipilo erythrophthalmus*, and variation in time elapsing between first call and first song of the day, on clear mornings only. Records were made in 1955 and 1956 at the Hastings Reservation. Those figures with superscript +-signs in the second column from the right are approximations only.

The period July 3 to 14, when song came about five minutes later than during the period May 16 to June 29, may represent a transition toward the abrupt shift to lateness occurring in the last half of July and persisting throughout August, as indicated by the songs of one aberrant, unmated male in 1955. Records between September 18 and October 2 average slightly later than those for August, but they are too few to be significant.

Another well-marked trend was noted in the amount of calling that males did prior to their first song of the day, as indicated by the average number of calls preceding first song and the average time elapsing from first call to first song (fig. 5). The most pronounced breaks occur between the end of April and the middle of May, and between the middle and the end of July. Here, the evidence indicates that, although earliness of first song might have been similar in the last half of April and the first half of May, the amount of calling prior to first song was not. On the clear morning of April 19, a male called 40 times before he sang; on clear mornings between May 1 and 15, four males for which calls were counted called 0, 7, 0, and 0 times (average, 1.75). Six males for which calls prior to first song were recorded on overcast mornings between April 16 and 28 averaged 37 calls; three males on the overcast mornings of May 7 and 12 averaged 2.33 calls (0, 0, and 7), and nine males on overcast mornings during the entire month of May averaged only 11.6 calls. The virtual elimination of calling prior to first song apparently occurred between May 1 and 15, starting with the onset of the nesting season.

The gradual increase in the amount of calling between May 1 and June 29 may have been coincidental, as the differences between successive two-week periods are slight. The slight increase in calling in the period from July 3 to 13, paralleling the slight decrease in earliness of first song in that period, may have been a transition toward the precipitous increase in calling noted between July 17 and 31, which paralleled the great increase in lateness of song in that period.

The Rufous-sided Towhee was not the only species to show a seasonal decrease in the amount of calling prior to first song, followed by a gradual increase later in the season. The Western Flycatcher and the Western Wood Pewee also showed such seasonal variation in their singing program, although on a different monthly schedule than that of the towhee.

Songs on overcast mornings averaged later than those heard on clear mornings. Since overcast days were, for the most part, interspersed in irregular fashion with clear days, the average time of first song on overcast mornings was compared to the average time of first song heard on clear mornings within two days, before and after, of each overcast morning. The overall averages are: clear mornings, 16.4 minutes before civil twilight, and cloudy mornings, 10.3 minutes before civil twilight. The average difference of 6.1 minutes is rather close to the 4.5 minutes difference found in the Song Sparrow by Nice (1943:106). Males called more before singing on overcast mornings. In March and April, eight males averaged 23.2 calls on clear mornings, and nine males averaged 34.6 calls on cloudy mornings. The corresponding figures for May are 2.2 calls for 15 males and 11.6 calls for nine males.

Discussion.—A number of features of the singing of the Rufous-sided Towhee show seasonal variation. The appearance and disappearance of song, height of singing perch, complexity of song, amount of singing, time of awakening song, and times of first and last vocalizing of the day relative to sunrise and sunset all show variation which correlates either with the onset and progression of the gonad cycle, or with a given individual's status in the breeding season. Initially, the question is, what effect, if any, does the gonad cycle have on singing, and what is the effect on the singing of an individual of his status as a breeding bird.

In 1955, song was first heard on January 31. At about this time (February 2) Leydig

cells ranged from fairly common to common in the testes of three males, and a definite increase in the average numbers of Leydig cells had been noted between January 5 and February 2. In 1956, singing appeared on February 1; again, Leydig cells in the testes of males taken at about this time (February 4) ranged from fairly common to common. Thus, singing did not appear in any male until there had been an increase in the Leydig cells in the male population generally. In 1955, singing was considered widespread in the male population by February 16. Between February 2 and 16, 1955, there was a further increase in the numbers of Leydig cells; a similar increase was noted between February 4 and 15, 1956. The spread of singing through the male population thus appeared to correlate with an increasing level of Leydig cells in the first half of February.

Nice (1937:63–65), with 15 records of the date of first singing of the Song Sparrow at Columbus, Ohio, found a high degree of correlation between the date of first singing and the mean temperatures on that date and on the two days previous. She noted some singing on January 7 and 8 following two warm days, and from January 13 to 21 following one warm day. She also noted that as singing appeared on later dates, it appeared at progressively lower temperatures, and the appearance of song followed a curve which indicated that the temperature threshold decreased about 0.75°F. per day. For the Rufous-sided Towhee, temperatures are available for eight dates for the start of singing. No well-marked correlations or trends are discernible. At the Hastings Reservation, the maximum deviation of mean temperature from normal, either positive or negative, was at the most 5.8 degrees on any date, and the proportional divergence from normal was even less than at Columbus, since the mean temperature there in January was 29°F. (*op. cit.*: 224), and the 18-year mean for this month at the Reservation is 47.2°F. The apparent lack of correlation with temperature in the Rufous-sided Towhees is very probably a result of the milder and more even climate in which they live. The amount of excess temperature (summed daily excess above normal after December 31) also shows no correlation with the appearance of song.

At the Reservation, the dates of first appearance of song refer to only a few individuals which were apparently advanced in their readiness to sing, and there was no correlation between the first singing of such individuals and the minor fluctuations in mean environmental temperature that preceded singing. But the dates were not those on which singing was widespread in the male population. It is not possible to tell from Nice's account what proportion of the total population was singing on any given starting date. Hence, my limited data, although showing no correlation, serve to stress the point that no correlation need necessarily occur and that any test of significant correlation between first song and temperature requires populational samples.

Since there is some evidence that low temperatures may retard the gonad cycle (Blanchard, 1941; Burger, 1948; Davis and Davis, 1954; Engels and Jenner, 1956; Marshall, 1951), it seems possible that the correlation found by Nice between environmental temperatures and the starting dates of song may be secondary, and that the primary correlation may be between temperature and the gonad cycle, with the start of singing merely an indication of the degree of an individual's gonadal development on a given date. This might explain the lowering of the temperature threshold by 0.75°F. per day; in other words, this might be another way of saying that the degree of gonadal development necessary for the appearance of song takes one day longer to come about for every drop in temperature of 0.75°F. One must assume that if the temperature threshold for the appearance of song drops steadily with the passage of time, either some physiologic change must be occurring in the individual, or some change in the social structure of the population must provide the stimulus for song. The latter does not seem

likely, as "hostile behavior towards territorial rivals *begins at the time that singing is well established*" (Nice, 1937:67, italics mine). Further evidence for temperature-gonadal control rather than for direct temperature control over the start of singing is found in the fact that singing in the Song Sparrow ceases in November and "no matter what warm and pleasant weather may occur in December, only occasional snatches of song are heard" (*op. cit.*: 63).

The lack of correlation found by Nice (*op. cit.*:66–67) between the amount of total daily sunshine and the amount of singing by Song Sparrows in January and February cannot be considered as evidence against the gonadal control of early season singing. Bartholomew (1949:462–6) investigated the effect of variation in natural light intensity on the testis cycle of the House Sparrow. Except near sunrise and sunset, the lowest light intensity recorded, during a violent snow squall, was far above the threshold necessary to bring about maximal gonadal development. Since figures for total daily sunshine do not indicate light values near sunrise and sunset, the former statistic is not significant in this regard.

In the Rufous-sided Towhee, the noticeable shift toward the earliness of awakening song that starts at about mid-April correlates with the attainment of breeding condition in the males. Although Leydig cells were classed as "very common" by mid-March, studies on other passerines, using special histological techniques (*Corvus monedulus*, Threadgold, 1956*a*, 1956*b*) or very detailed methods of estimating the amount of the glandular components of the intertubular tissue (*Zonotrichia leucophrys gambelii*, Blanchard and Erickson, 1949) indicate that the interstitial cells increase up to the time that breeding condition is achieved. If the Rufous-sided Towhee follows this pattern, as seems likely, then the maximum development of the interstitial cells would have occurred in mid-April, when the males came into breeding condition. The shift in the time of awakening song that occurred in mid-April apparently coincided with maximum gonadal development. The shift in the time of awakening song from a relatively late time in January and February to an earlier time in March and the first half of April occurred at a time when the testes were still undergoing development, both inter- and intratubularly. This shift may thus be a response to the increasing level of interstitial cells.

Nice (1943:103–104) noted a shift toward earliness of awakening song in the Song Sparrow from a "basic" period in January and February to an "intermediate" period in February and March. She correlated this shift with the excess temperature occurring during the two weeks preceding the shift in each year. She also found evidence of a decreasing temperature threshold, the shift occurring after a smaller amount of excess temperature the later it was noted. Again, it seems probable that the primary correlation was between temperature and gonadal development, and she states that "[the intermediate period] was never reached in January no matter how warm the weather . . . ." (*op. cit.*:104).

If singing were controlled solely by the gonadal development of the individual, we would expect a steady increase in the singing of the Rufous-sided Towhee from about the beginning of February through the middle of April. However, this was not the case, as there was a noticeable decrease in singing during the first half of April, just as the males were coming into breeding condition. Further, during the breeding season, unmated male towhees sing considerably more than mated males. This was true of unmated males heard in April, May, and June. This phenomenon has been reported for a number of species (see, for example, Nice, 1943:172–174), and in some cases the arrival of a mate suppresses song instantaneously and completely (for example, in the Snow Bunting, *Plectrophenax nivalis*, Tinbergen, 1939:77). The difference in the amount of sing-

ing between mated and unmated males appears to exist independently of gonadal development, and certainly the instantaneous, or nearly instantaneous suppression of song in an unmated male when a mate appears cannot be thought of as under gonadal control. Nice (1943:119) lists a number of changes in the amount of singing by Song Sparrows which correlate with the progression of events in the nesting cycle. She found that song was inhibited just prior to nesting, but that it was uninhibited during building, laying, and incubating. Male passerines usually reach breeding condition before the females do; in the Song Sparrow in the San Francisco Bay region of California, males reach breeding condition from four to six weeks ahead of the females (Johnston, 1956:32). Surely the males studied by Nice had reached maximal gonadal development well before nest building got under way. Yet, singing was noticeably inhibited prior to building and uninhibited later. Such changes in the amount of singing do not correlate with gonadal changes, but they appear to depend on the events in the nesting cycle taking place at a particular time.

Nice (*loc. cit.*) noted that song was inhibited after the appearance of young in the nest. In the Rufous-sided Towhee, a similar decrease in the amount of singing was noted in males which had young in the nest. It may be that the appearance of young evokes other hormonal activity and that this, in turn, may cause a regression of the gonads with a concomitant decrease in the amount of singing. The hormone involved would probably be prolactin, which evokes parental behavior. Lofts and Marshall (1956: 105) state, "It has been known for many years that the artificial administration of prolactin leads to testis collapse in birds (Riddle and Bates, 1933). This is now shown [in *Passer domesticus, Fringilla coelebs,* and *Chloris chloris*] probably to be identical with the tubular steatogenesis, involving also the production of cholesterol, that occurs naturally in wild seasonal birds when the young hatch and are being fed by the parents." Bailey (1950:249) noted that prolactin, in addition to blocking the response of the testes of *Zonotrichia leucophrys pugetensis* to light treatment, also inhibited the singing of treated birds, as opposed to the controls, which sang loudly and frequently. It seems possible that the suppression of song in male Song Sparrows and towhees after their young have hatched is under hormonal control. However, the testes of male towhees throughout June and the first week of July contained greatly expanded tubules, an abundance of grouped spermatozoa, and a minimum of interstitial tissue per section, this narrowly compressed between adjacent tubules. All these features are typical of testes in full breeding condition. That some decrease in testis volume had occurred in June is indicated by the fact that the volume of five testes of adults in breeding condition in April and May (longest and shortest diameters measured to the nearest 0.5 mm.) averaged 315.9 mm.^{3}, whereas seven testes of breeding adults taken between June 8 and July 6 averaged 267.1 mm.^{3}. However, this difference in volume is hardly indicative of any pronounced tubular collapse.

The whole problem of testis regression possibly induced by prolactin following the appearance of young in the nest is further complicated by the fact that many passerines commonly raise two or more broods in a single season. In the period from 1954 to 1956 at the Hastings Reservation, most pairs of the Rufous-sided Towhee raised only one brood, as indicated by the size of juveniles noted during the spring and summer months. That some pairs raised two broods is indicated by the collecting of a very small, bob-tailed juvenile, probably two days out of the nest, on August 2, 1955. In other parts of the range, such as at Berkeley, California, where conditions are more humid, Rufous-sided Towhees commonly raise two broods, and the potential to breed twice in a season is undoubtedly inherent in the species. In species, or populations, which normally raise two or more broods a year, it must be assumed that if prolactin secretion in the male,

following the appearance of the young in the nest, depresses the gonads with a concomitant depression of song, such gonadal suppression cannot be final, or similar to the eventual collapse of the gonads at the end of the breeding season, as the male would not be sexually competent when it came time to start a second nesting. Further, in any species, the first nest may be destroyed after the young have hatched but before they have fledged. If prolactin had caused an irreversible gonadal regression by the time of nest destruction, a renesting would be impossible.

Although it is possible in the laboratory to bring about a pronounced collapse of the gonads by the administration of prolactin, it seems likely that in nature a very delicate balance is achieved between gonadal function and other hormonal activity. This would insure the participation of the male in rearing the young in those species in which both sexes participate in this activity, yet it would allow the male to maintain, or recover, sexual competence so that renesting or second nesting is possible. At least some recovery of male breeding behavior following the fledging of first brood young in the Song Sparrow is indicated by Nice's statement (1943:175) that pouncing, the courtship display of the male, "is confined typically to the early stages of the nesting cycle . . . It may reappear, however, the day that the young leave the nest, if another brood is to be started immediately."

The disappearance of singing in the Rufous-sided Towhee in late summer correlates with both gonadal regression and molt. The most pronounced decline in singing, as indicated by census records (table 6), the noticeable shift toward lateness of awakening song (fig. 4), and the increase in calling prior to awakening song (fig. 5), all appeared on about July 20. This was also the first date on which the testes of all males showed signs of regression, and it was the first date on which molting males were collected. It seems likely that both factors play a part in bringing about the cessation of song. However, it seems unlikely that molt, although it is a severe drain on the energy resources of the individual, would alone be sufficient to inhibit the singing of a few trills, at least early in the morning. Yet, such inhibition occurs. Actually, molt and gonadal regression should not be thought of as completely separate, unrelated processes. In many species, both passerine and non-passerine, molt is preceded by a period of thyroid activity, and the suggestion has been made that increased thyroid function may interfere with gonadal development (Davis and Davis, 1954:342). It is futile to speculate on which factor, molt or gonadal regression, has the most profound effect on singing, as we are by no means justified in assuming that these are entirely independent processes, at least in north temperate birds.

In the fall, the slight but regular appearance of song in a few male Rufous-sided Towhees may be evidence of a slight rise in gonadal activity in such individuals. There was no evidence of gonadal recrudescence in any adult, but one first-year male had gonads which were in Stage 3, spermatogenically, and the gonads of this male and two others of a total of seven first-year males collected between September 14 and October 12, 1955, contained occasional Leydig cells, whereas these cells were classed as either "rare" or "small and rare" in the testes of seven adults collected during the same period. Further, several songs heard in September were noticeably aberrant, suggesting that they might have been the songs of first-year males. It may be, then, that the gonads become slightly active in a few first-year males, perhaps individuals hatched unusually early in the breeding season, and that such birds are responsible for the few brief periods of singing heard each fall.

It should be noted that song is heard in the fall and winter in several species of territorial birds, but in at least one instance, there was no sign of gonadal activity at that time. In *Zonotrichia leucophrys nuttalli*, which remains on its breeding territory through-

out the year, Blanchard (1941:13) had many records of fall and winter song, but she found that the gonads of this race were completely inactive from early or mid-October at least to middle or late December (*op. cit.*:52). *Zonotrichia leucophrys pugetensis*, which is a winter resident at Berkeley, arrives there in late September and early October in large flocks, and it is therefore not territorial at that time. Yet, these birds are singing on their arrival at Berkeley (*op. cit.*:39), although the males start to undergo gonadal regression in late July and early August, and "by the time they arrive on their wintering grounds their testes, if we may judge from volume alone, have already reached the inactive condition" (*op. cit.*:87). In the winter resident Golden-crowned Sparrow (*Zonotrichia atricapilla*), which is not territorial on its wintering grounds, considerable singing is heard in September and October when it arrives in California, but the gonads at that time "are at winter size and condition" (Miller, 1948:3). It is possible that such singing in non-territorial winter residents has to do with the establishment of dominance relationships in winter flocks, but even so, it is apparently not under gonadal control. The problem involving fall and winter song, and its cause and control, are very complex for those species in which there is no well marked autumnal gonadal activity, and such singing apparently depends on behavioral factors which are not understood at present.

In the Rufous-sided Towhee, there were individual instances of singing that could not be explained on the basis of gonadal control, temperature factors, or the position of the male in the breeding cycle. Song heard on August 10, 12, 13, 26, and 30 occurred at a time when males are far into the molt and gonadal regression. One male sang on November 26, at a time when the gonads are at the winter minimum. This date is about three and one-half months after the normal cessation of summer song, about six weeks after the cessation of fall song, and about two months before the first appearance of song near the beginning of the next reproductive cycle. In 1955, a male sang on January 5, and the next singing was not heard until January 31. The most aberrant bird was an unmated male whose awakening song had been heard over a long period of time in 1955. Another male in the same area sang his last awakening song on July 27, but the unmated male sang an awakening song on every morning on which observations were made up to and including August 9, and subsequently on five of 11 mornings (four clear, one overcast) of observation up to and including September 5, when his last awakening song was heard. In 1955, the last song heard from any male other than this one was noted on August 7. On August 11, the unmated male sang 8 to 10 loud basic trills at 8:35 a.m. and on August 16, he sang 11 basic trills, about two-thirds normal volume, at 7:04 p.m. The persistence of this bird in singing an awakening song almost throughout the period of molt and gonadal regression could not be explained.

SUMMARY

The gonad cycles of the Rufous-sided Towhee near the Hastings Reservation were determined for the breeding seasons of 1955 and 1956. Males reached breeding condition at about mid-April and females about two weeks later. The testes of all males were regressing by July 20. The interstitial tissue showed an initial increase in the numbers of Leydig cells between mid-January and the beginning of February and a further increase from the beginning of February to at least mid-March.

The singing behavior of the Rufous-sided Towhee at the Hastings Reservation is described. Singing usually starts between mid-January and the first week of February, and it comes to an end in early August. In September and October, there is a slight but regular appearance of singing, involving only a few males.

Singing is widespread by mid-March, but in early April there is a noticeable decrease in the amount of song. By the last week in April, at the time that nesting gets under

way, singing is again at a high level. Nesting males sing a higher percentage of the time during incubation than after the young have been hatched. Unmated males are the most persistent singers of all.

Awakening song comes earliest in relation to sunrise and morning civil twilight from mid-April to the end of June. During the first two weeks in July it comes somewhat later, and by July 20 it comes at a much later time.

The beginning of singing correlates with the initial increase in the number of Leydig cells in the interstitial tissue, and the establishment of song in the male population correlates with the further increase in Leydig cells during the first half of February. The pronounced increase in the earliness of awakening song starting in mid-April occurs when males have reached full breeding condition. The great decrease in the amount of singing and the lateness in the time of awakening song in the latter part of July correlate with the onset of molt and gonadal regression. The limited but regular appearance of singing in September and October may correlate with the slight increase in the number of Leydig cells that occur in those months in the testes of a few first-year birds.

The decrease in singing during the first half of April and the apparent decrease in singing by an unmated male after he had become paired do not appear to correlate with any gonadal changes.

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Hastings Reservation, University of California, Carmel Valley, California, December 6, 1957.

FROM FIELD AND STUDY

Harris Sparrow from Humboldt County, California.—On February 1, 1958, a large sparrow was observed at a feeder in the company of Fox and White-crowned sparrows (*Passerella iliaca* and *Zonotrichia leucophrys*). The bird spent the entire day in the immediate vicinity. On the next day the bird was still present and it was collected. On closer examination it was found to be an immature Harris Sparrow (*Zonothrichia querula*). The identification was verified by Dr. Charles Yocom of Humboldt State College.

The exact location of this collection was on the north side of the mouth of the Mad River, four miles north of Arcata, Humboldt County, California. There are a number of records of Harris Sparrow from scattered areas of the state. To my knowledge, this is the first record for Humboldt County and the northern coastal area of California. The specimen has been placed in the Humboldt State College collection.—Warren J. Houck, *Humboldt State College, Arcata, California, February 5, 1958.*

Inland Occurrence of Black Turnstone.—On August 28, 1957, below Inwood Cabins along the south shore of Lake McDonald in Glacier National Park, Montana, my attention was attracted about 4 p.m. to a larger than usual "sandpiper" foraging at the waterline and moving east toward the upper end of the lake. Approaching to within 25 feet, I observed with binoculars that this bird had chiefly slaty to sooty-black plumage. It proved to be a little under Killdeer size and it showed in every detail the characteristic black and white feathering, and the bill and leg colors of the Black Turnstone (*Arenaria melanocephala*) in postbreeding plumage.

Circling ahead, I outdistanced the forager and came down to await it at the waterline. At three yards the shorebird took flight and passed within a few feet of me to alight just beyond me. On closing its wings, the migrant turnstone quickly extended them upward again over its back until the black primaries almost met in a Willet-like movement that once more displayed the diagnostic patterns of dorsal surface and upper and under wing.

Previously, the farthest known inland occurrences of this Pacific coastal species have been records from Watson Lake, Yukon; the Atlin region and Nulki Lake, British Columbia; Washington County, Oregon; and the Salton Sea, Imperial County, and Needles, San Bernardino County, California (A.O.U. Check-list, Fifth Edition, 1957:176–177). All of these records were made within 225 miles or less of tidewater.—John L. Blackford, *Libby, Montana, January 28, 1958.*

Oldsquaw Found at La Jolla, California.—As there appears to be no record of an Oldsquaw (*Clangula hyemalis*) in southern California waters since 1938 (Sefton, Condor, 41, 1939:83; Grinnell and Miller, Pac. Coast Avif. No. 27, 1944:86), the presence of a dead bird of this species on the beach at La Jolla, San Diego County, California, on January 25, 1958, is of interest. The bird was found after a storm at the high water mark about 50 yards north of the Scripps Pier in La Jolla by Mr. A. G. Morley, Jr. The specimen, a male, was debilitated and did not have complete winter plumage. It was turned over to Mr. Laurence M. Huey, of the San Diego Natural History Museum, and it is now in the collection of that museum.—Arthur G. Morley, Jr., *San Diego, California,* and James R. Sams, *San Diego Natural History Museum, San Diego, California, February 8, 1958.*

Female Gadwall Returns to Nest Site After Loss of Young.—On July 13, 1956, at Ogden Bay Refuge, Weber County, Utah, I discovered a female Gadwall (*Anas strepera*) that had returned to her nest to resume incubating three unhatched eggs after the apparent loss of her newly-hatched young. The events which led to this observation are as follows.

A study of the Gadwall's breeding behavior which I made in 1956 and 1957 required the recognition of individual females. To this end, incubating birds were trapped on their nests by means of a nest trap described by Sowls (Trans. N. Amer. Wildlife Conf., 14, 1949:260–275) and individually marked with "Koroseal" plastic neck tags of the type designed by Taber (Jour. Wildlife Manag., 13, 1949:228–231). The particular female with which this article is concerned was trapped and marked on June 21, 1956. On that date her nest contained 10 eggs in the ninth day of incubation, but at the time of hatching the clutch had been reduced to five eggs as the result of predation by California Gulls (*Larus californicus*). The nest was situated in the weedy cover of a dike bank, about five yards from an adjacent borrow pit.

On the morning of July 5, when I returned to the nest to determine its fate, I found two young that had hatched the evening before being brooded at the nest and three unhatched eggs (later found

to contain dead embryos). At my approach the two chicks hurried out of the nest, down the dike bank and into the borrow pit where their mother was calling loudly and performing distraction displays Recording the nest as having been partially successful, I moved on to check on the progress of other nests. However, eight days later, on July 13, I happened to pass the site again and found the female back on her nest incubating the unhatched eggs. I do not know the exact date of her return, but I found her at the nest on each of the next three days, July 14, 15, and 16, before she finally abandoned the three addled eggs. During this period, her identity was confirmed twice by observation of her colored neck tag.

Apparently, soon after leaving the nest, the bird's two young became lost, or possibly they were killed by California Gulls, which nest in large numbers at Ogden Bay, and Odin (Auk, 74, 1957:185-202) cites several instances of their predation on young waterfowl in northern Utah; following this the hen returned to incubate what remained of her original clutch in response to an incubation drive that persisted even after the time of hatching.—JOHN M. GATES, *Utah Cooperative Wildlife Research Unit, Logan, Utah, January 24, 1958.*

Kiskadee Flycatcher in San Jose, California.—On February 1, 1958, a Kiskadee Flycatcher (*Pitangus sulphuratus*) was observed in a residential area at San Jose, California. According to residents the bird had been in the vicinity for about four months. The only other record of this species for California was that of a female taken in 1926 at Inglewood, Los Angeles County (Wyman, Condor, 29, 1927:23).

The bird was observed for about 20 minutes at close range, and the black and white stripes on the head, yellow crown-patch, sulphur-yellow underparts, rufous wings, and relatively short tail were all evident and clearly established its identity as a Kiskadee Flycatcher. The bird was observed feeding on bread placed out as food for birds by the residents of the area. This may in part explain its survival for at least four months in this locality. Whether it is an escaped caged bird or a natural stray was not determined.—H. THOMAS HARVEY, *San Jose State College, San Jose, California, February 10, 1958.*

Some Prey of the Pygmy Owl.—Two observations of the Pygmy Owl (*Glaucidium gnoma*) securing food have been noted at the Hopland Field Station at Hopland, Mendocino County, California. On December 21, 1957, at 1:30 p.m., a Pygmy Owl carrying a meadow mouse (*Microtus californicus*) was seen flying rapidly about four feet above the ground. The adult mouse, which was recovered, was still warm and had probably been caught under an oak tree whence the owl had flown; it weighed 55.4 grams. The owl, which has been catalogued at the Field Station, was a female weighing 76.1 grams. The stomach of the owl was distended by its contents of a juvenal deer mouse (*Peromyscus maniculatus*) and a Jerusalem cricket.

The second observation was made earlier in the year at 8:00 a.m. when a Pygmy Owl was heard and seen falling to the ground in a struggle with a Nuttall's Woodpecker (*Dendrocopos nuttallii*). On the ground the owl held firm as the woodpecker struggled a few more seconds. After some moments hesitation, the owl flew with its prey to a branch 50 feet away. At this point the sudden approach of another observer caused the owl to drop its prey and take flight.—ELBERT M. BROCK, *University of California Field Station, Hopland, California, February 27, 1958.*

A Range Extension of Meleagris gallopavo mexicana into Southwestern New Mexico.—The A.O.U. Check-list of North American Birds, Fifth Edition, 1957, lists *Meleagris gallopavo merriami* as the only race of Turkey occurring in southern New Mexico. A specimen collected in 1957, however, indicates that the range of the race *Meleagris gallopavo mexicana* extends north into Hidalgo County, New Mexico. On May 16, 1957, an adult female Turkey was caught in the Peloncillo Mountains of Hidalgo County, New Mexico. The exact collection site was in Section 7, Township 33, Range 21, at approximately 5000 feet elevation. This location is about 7½ miles north of the Mexican border and 3½ miles east of the Arizona border. The bird was sent to the Museum of Vertebrate Zoology and there identified by A. Starker Leopold as *M. g. mexicana* (MVZ 135247). The Turkey weighed ten pounds. It had a five- to six-inch beard, and the largest ovum measured 11 mm. Only one other verified collection of *M. g. mexicana* has been made in this general area. A female (U. S. Nat. Mus. 126718) was collected on May 31, 1892, by Mearns and Holzner in the San Luis Mountains on the México-New Mexico boundary line (John W. Aldrich, 1957, *in litt.*).

Friedmann, Griscom, and Moore (Pac. Coast Avif. No. 29, 1950) list *mexicana* as occurring as far north as Chihuahua, México. Although the specimen collected in 1892 was taken on the border, the bird collected in 1957 extends the range of this Mexican race into southern New Mexico.

A review of sight records by Ligon (Wildlife of New Mexico, 1946:20) disclosed the presence of native Turkeys in the Animas Mountains of New Mexico as late as 1908. After 1908, the absence of reports of Turkeys in the area suggested their disappearance. The Animas Mountains extend northward from the San Luis Mountains and both ranges are a few miles east of the Peloncillo Mountains.

Between 1929 and 1939, four separate transplants of Turkeys, totaling nineteen females and nine males of the race *merriami*, were made in the northern portion of the Animas Mountains when it was believed that native Turkeys had been exterminated from that area. It should be noted that the Turkey habitat in the Animas and Peloncillo mountains is quite different from that found in the range of *merriami*. From interviews with ranchers and Game Department personnel, it is surmised that the transplanted *merriami* did not become adapted to this area and disappeared rapidly after the last release. Sight records by ranchers and Game Department personnel since 1940 indicate that *merriami* is not present in southern Hidalgo County but that *mexicana* has moved from adjacent México into suitable areas. Further collections of specimens from both the Animas and Peloncillo mountains are planned in an effort to substantiate this belief.—Wayne H. Bohl, *Fish and Wildlife Service, Sacramento, California,* and Sidney Paul Gordon, *U. S. Forest Service, Grass Valley, California, February 16, 1958.*

On the Distribution of Day's Barbet.—In August, 1950, I collected a specimen of Day's Barbet (*Capito dayi*) on the upper Rio Teles Pires, the eastern headwaters of the Rio Tapajóz in the northern part of the State of Mato Grosso, Brazil. This locality is about 600 kilometers from the locality on the Rio Madeira from which Cherrie (Bull. Amer. Mus. Nat. Hist., 35, 1916:394) described this species. Since the Madeira–Guaporé and the Teles Pires–Tapajóz river systems are adjacent, the occurrence of this species in the Rio Teles Pires was not surprising. However, the discovery of Day's Barbet on the lower Rio Tocantins, in the State of Pará, was unexpected. A specimen collected by native hunters at Marabá was sold to me by J. Hidasi. In August, 1957, I secured another specimen in the eastern Tapajóz region, on the upper Rio Cururú in the State of Pará. This record partially bridges the gap of about 1000 kilometers in the distribution of the species, between the Rio Teles Pires and the Rio Tocantins.

The three specimens, all adult, correspond closely in size and color with a series of nine birds in the Museu Nacional at Rio de Janeiro. This series was collected by the Commissão Rondon in the Guaporé region (Rio Guaporé, Javarí, Jaurú) in 1908, 1909, and 1914. The measurements of the Rondon specimens are as follows: wing, six males, 92.2 mm. (90-94); tail, five males, 52.8 mm. (51–54); for three females, wing, 91.3 mm. (90–94) and tail, 53.0 mm. (52–54). My specimens from the Rio Tapajóz are a male, weighing 65 grams, with a testis 5 mm. long, and a female weighing 66.5 grams, with an ovary 9 mm. long. The male measures: wing, 89, and tail, 54 mm. The female measures: wing, 90, and tail, 52 mm. The wing and tail of the specimen from Marabá, a male, measure 90 and 52 mm., respectively. The white upper breast feathers of all 12 specimens are somewhat stiff. Some of the males have a few scarlet feathers in the dorsal white patch; the female from the Rio Cururú has a scarlet feather over each eye.

The stomach of the specimen from the Rio Teles Pires contained spiders; the bird had a larva of a sucking fly of the genus *Philornis* on its neck and a helminth in its body cavity. Mallophaga were present on its feathers. The stomach of the specimen from the Rio Cururú contained fruit.—Helmut Sick, *Fundação Brasil Central, Rio de Janeiro, Brazil, December 1, 1957.*

Geographical Variation in the Vocalizations of the Western Meadowlark.—Until recent years our knowledge of the extent of geographical variation in the vocalizations of birds has been limited and generally of a subjective nature. The advent of modern technological advances in the fields of sound recording and analysis has opened up new vistas of research and some progress has already been made. There are now enough observers with access to the necessary field and laboratory equipment to make such geographical comparisons feasible. We submit the following data to illustrate how collaboration among workers in bio-acoustics can contribute toward this goal.

The characteristic call note of the Western Meadowlark (*Sturnella neglecta*), phonetically described as the *chupp*, has been analyzed and interpreted in connection with another study (Lanyon,

Publ. Nuttall Ornith. Club No. 1, 1957). The sound spectrograms in figure 1 are of recordings of this call note made at four different localities. Each locality reflects a different situation with regard to (1) geographical location within the species' range, and (2) potential environmental influence of a sibling species, the Eastern Meadowlark (*Sturnella magna*). The localities represented are: Kern County, California (May 30, 1946), well within the range of *neglecta* with no possibility of *magna*

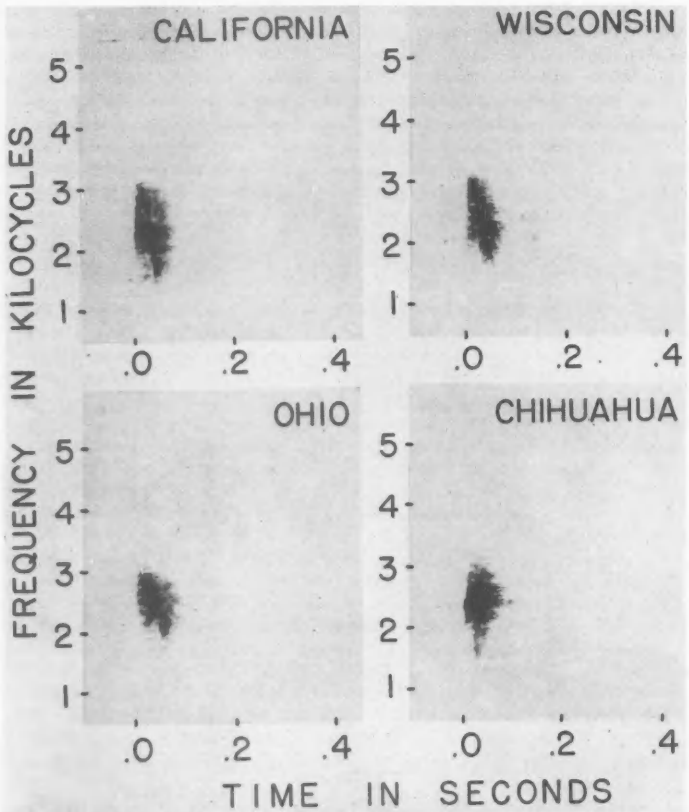

Fig. 1. Sound spectrograms of the characteristic call note of the Western Meadowlark, recorded in four widely separated populations.

influence; Dane County, Wisconsin (May 15, 1953), in the zone of common overlap of *neglecta* and *magna;* Wayne County, Ohio (April 27, 1957), where peripheral breeding *neglecta* are surrounded by *magna*; and Santa Ana Babicora, Chihuahua, México (June 15, 1957), where peripheral *neglecta* breed in the absence of *magna*.

In Wisconsin, this call note (fig. 1) was found to consist of frequencies of 2.0 to 3.0 kilocycles and to last less than 0.1 second (Lanyon, *op. cit.*). The other spectrograms in figure 1 show sound patterns that are essentially identical to this. Collectively, they suggest that Western Meadowlarks render the same characteristic call note regardless of their geographical location within the species' range. They further suggest that the inheritance and/or maturation of this call note is independent of

the presence or absence of the sibling species. In the light of growing evidence that call notes are less influenced by environmental stimuli than is primary song, it might be profitable to focus more attention on the potential use of these simple, explosive types of vocalization in systematic studies.

It has been demonstrated that the development of species-specific primary song in juvenal meadowlarks is highly dependent upon environmental stimuli subsequent to the time of fledging, and that the absence of the appropriate stimuli can result in failure to acquire the characteristic song of the species (Lanyon, *op. cit.*). Presumably, this learned basis of primary song is responsible for the geographical variation or "dialects" that have been reported in various parts of the ranges of meadowlarks (and perhaps in other passerines as well).

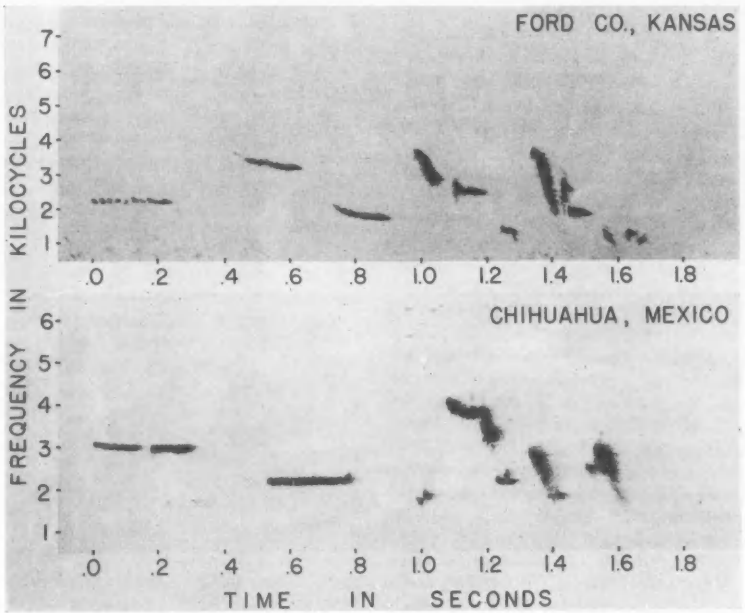

Fig. 2. Sound spectrograms of primary song of the Western Meadowlark, recorded in two different populations.

In spite of this demonstrable geographical variation in the primary song of meadowlarks, widely-separated breeding populations appear to retain certain basic features in their primary song patterns that are characteristic of the species as a whole. For example, primary song in the Chihuahuan population of *neglecta* referred to above, although differing in the detail and arrangement of the component elements, was found to have the same basic features illustrated by *neglecta* breeding in western Kansas: (1) sound energy concentrated in the range of 1 to 4 kilocycles and (2) division into two phases, an introductory group of rather pure tones and a concluding phase of more complex, "steep slope elements." These features are illustrated by the sound spectrograms in figure 2 (made on two different models of sound spectrographs, accounting for the difference in frequency scales).

The sound spectrograms were prepared at the Southwestern Research Station of the American Museum of Natural History and at the University of Wisconsin. We wish to thank Joseph Beatty of Wooster, Ohio, for aid in recording isolated *neglecta* in Ohio. The field work in Chihuahua was supported by funds from the American Philosophical Society.—WESLEY E. LANYON, *American Museum of Natural History, New York, New York,* and WILLIAM R. FISH, *China Lake, California, January 9, 1958.*

NOTES AND NEWS

The frontispiece is based on drawings by Gene M. Christman prepared from specimens and, in the case of *Phoenicoparrus jamesi*, from photographs by F. Behn. In addition detailed descriptions by A. W. Johnson and color sketches by W. R. Millie were used. The plate was printed by a three-color process using an original drawing with two overlay drawings.

COOPER SOCIETY MEETINGS

SOUTHERN DIVISION

JANUARY.—The regular monthly meeting of the Southern Division was held on January 28, 1958, at the Los Angeles County Museum. The following names were proposed for membership: Leslie M. Baylor, 1100 So. Miller Ave., Mitchell, S. D., by Francis H. Boynton; Oscar Walter Johnson, 122 Audubon Way, Pullman, Wash., and Peter E. K. Shepherd, 280 South Fairway, Pullman, Wash., both by Irven O. Buss; Paula S. Boyer, 420 E. Second Ave., Roselle, N. J., George Brem, Jr., 211 No. Princevalle St., Gilroy, Calif., George Andrew Dorsey, Darlington School, Rome, Ga., S. Norris Gluck, 305 Beauregard St., Charleston, W. Va., Nicholas Gravem, Jr., 200 Elm Avenue, Mill Valley, Calif., Mrs. Louise Hoover Hauselt, Davenport, Calif., and William H. Moore, M.D., 919 Grace St., Bakersfield, Calif., all by C. V. Duff; Chas. Bertram Schaughency, Village Road, Green Village, N. J., and Arthur B. Singer, 30 Hightop Lane, Jericho, L.I., N.Y., both by Don R. Eckelberry; Rufus B. von Kleinsmid, University of Southern California, Los Angeles 7, Calif., by Ed N. Harrison; Fred S. Webster, Jr., 4926 Strass Dr., Austin 3, Tex., by Edgar B. Kincaid, Jr.; Daniel Lewis Fischer, 4845 Central Ave., Riverside, Calif., by Alden H. Miller; Gerald J. Bakus, 18624 48th Ave. West, Lynnwood, Wash., by Frank Richardson; William Dillon Hawes, P. O. Box 974, Lancaster, Calif., by Kenneth E. Stager; Kenneth E. Griffin, 2506 Glen Green, Hollywood 28, Calif., Raymond J. Grow, 513 West Fifth Ave., Gary, Ind., Jack P. Hailman, 4401 Gladwyne Dr., Bethesda 14, Md., Robert W. Kirkman, 9325½ Dearborn Ave., South Gate, Calif., Harvey Lee Patten, 1310 Thomas Ave. N., Minneapolis, Minn., Lowell O. Stephens, Jr., 911 Sheridan St., Laramie, Wyo., Don F. Sturzenacker, 157 No. Orange Dr., Los Angeles 36, Calif., W. G. Sutton, Jr., 1031 Bel Air Court, Los Angeles 24, Calif., John Garnett Tyler, 603 Alta Ave., Santa Monica, Calif., and Ernest Jordan Willoughby, 1102 Cedar St., Santa Monica, Calif., all by Jack C. von Bloeker, Jr.; and Paul A. Herman, 290 W. El Repetto Dr., Monterey Park, Calif., by Patrick Gould.

The Nominating Committee through its chairman, Ed N. Harrison, proposed that the incumbent officers of the Southern Division be elected for another year, whereupon the president called for further nominations from the floor; there being none, Sidney B. Peyton moved that the nominations be closed and that the secretary be instructed to cast an unanimous ballot for the incumbent officers. The motion was duly seconded and carried and the following officers were declared elected for the ensuing year: Thomas R. Howell, President; M. Dale Arvey, First Vice-President; Henry E. Childs, Jr., Second Vice-President; and Dorothy E. Groner, Secretary.

Elton L. Morel reported a Wilson's Plover at Malibu Creek on December 12. Pat Gould reported a Slate-colored Junco on the Occidental College campus, and Arnold Small stated that a Gray-headed Junco was seen at a feeding tray in Glendale on January 11. A Vermilion Flycatcher is wintering at the Audubon Nature Center in El Monte.

Speaker of the evening, Tom J. Cade of the Department of Zoology, University of California, Los Angeles, spoke on "Summer Birds of the Arctic Slope of Alaska."—DOROTHY E. GRONER, *Secretary*.

FEBRUARY.—The regular monthly meeting of the Southern Division was held on February 25, 1958, at the Los Angeles County Museum. The following names were proposed for membership: Donald A. Boltz, 1556 Brentwood Court, Walnut Creek, Calif., and Xion R. Langlois, 805 Paradise Rd., Modesto, Calif., by Jack C. von Bloeker, Jr.; Robert Stewart Constable, 6521 Blucher Ave., Van Nuys, Calif., by Charles A. McLaughlin; Rodolfo Escalante, Juan Benito Blanco 1030—Apto. 201, Montevideo, Uruguay, by Alden H. Miller; L. Lloyd Evans, 503 California Ave., Libby, Mont., by John L. Blackford; Charles O. Matcham, 2225 Robles Ave., San Marino, Calif., by Ed N. Harrison; J. Hill Hamon, Dept. of Biology, Univ. of Florida, Gainesville, Fla., and Robert David Weigel, Dept. of Biology, Univ. of Florida, Gainesville, Fla., by Pierce Brodkorb; Joseph L. Dvorak, 6125 W. Eddy St., Chicago 34, Ill., and Philip B. Heywood, 63 Beechmont St., Worcester, Mass., by C. V. Duff; and Ronald

Clinton Willis, 38703 N. 32nd St. East, Palmdale, Calif., by Kenneth E. Stager.

Gerhard Bakker, Jr., reported that a Steller's Jay was present in Huntington Park and that one had remained through the winter months last year. Sidney B. Peyton reported that in his yard a Bushtit and Bewick Wren have completed nests, both ready for eggs.

Kenneth E. Stager, Curator of Birds and Mammals at the Los Angeles County Museum, talked on "Birds of the Bolivian Chaco."—DOROTHY E. GRONER, *Secretary*.

MARCH.—The regular monthly meeting of the Southern Division was held on March 25, 1958, at the Los Angeles County Museum. The following names were proposed for membership: E. W. Carter, 234 Muirfield Rd., Los Angeles, Calif., by W. J. Sheffler; John H. Dearborn, Littlejohn Rd., Cape Elizabeth, Maine, and Byron E. Harrell, Dept. of Zoology, University of South Dakota, Vermillion, S. Dakota, both by Thomas R. Howell; Mr. U. Theodore Hammer, Camrose, Alberta, Canada, by Jack C. von Bloeker, Jr.; and Willis C. Royall, Jr., 262 South Meade St., Denver 19, Colo., by Joe Marshall.

Robert S. Constable reported a pair of Band-tailed Pigeons nesting in a phoenix palm at Sunset Boulevard and Fairfax Avenue, Los Angeles, on March 14, 1958.

"Bird Adventures in Southern Mexico and Central America" was the subject of a joint program given by Dr. and Mrs. C. A. Schroeder and Mr. and Mrs. Gerhard Bakker, Jr.—DOROTHY E. GRONER, *Secretary*.

NORTHERN DIVISION

FEBRUARY.—The regular monthly meeting of the Northern Division was held on February 6, 1958, at the University of California, Berkeley.

Mrs. Grace M. Miller, Box 103, Inverness, California, was proposed for membership by Howard L. Cogswell.

The following field observations were presented. Robert S. Arbib observed a Little Blue Heron in immature plumage at Bay Marshes, Redwood City, on January 4, 1958. L. Richard Mewaldt reported that a Kiskadee Flycatcher had been observed by Thomas Harvey in the Willow Glen District of San Jose from October, 1957, through January, 1958. The bird had been eating bread on a feeding shelf. Presumably, this individual was an "escape" from an aviary. Russell H. Pray observed a White-throated Sparrow in Berkeley on February 5 and 6. Paul F. Covel reported that Yellow-billed Magpies were observed along the Bear Creek Road, Contra Costa County, on the East Bay Christmas Bird Census, December 29, 1957.

The guest speaker was Dr. Oliver P. Pearson of the Museum of Vertebrate Zoology, who presented an illustrated talk entitled "A Traffic Survey in Wild Rodent Runways."—ROBERT I. BOWMAN, *Secretary*.

MARCH.—The regular monthly meeting of the Northern Division was held on March 6, 1958, at the University of California, Berkeley.

Martin A. Tucker, 33 Pala Ave., San Jose, California, and Dr. H. Thomas Harvey, 716 Garner Court, Santa Clara, California, were proposed for membership by L. Richard Mewaldt.

R. P. Parsons reported that a female King Eider was observed in the harbor at Monterey Bay on February 22, 1958. The bird was seen in the area for several days thereafter.

The guest speaker was Dr. L. Richard Mewaldt of the Department of Biological Sciences, San Jose State College, whose talk was entitled "*Zugunruhe*, the Night Restlessness of Caged Migratory Birds."—ROBERT I. BOWMAN, *Secretary*.

ANNUAL BUSINESS MEETING, 1958

The first session of the annual meeting of the members of the Cooper Ornithological Society (a corporation) was called to order by President J. R. Pemberton in the Little Theater, New Union Building, University of Utah, Salt Lake City, Utah, on April 25, 1958.

The minutes of the meeting of 1957 were read and approved. The following committees were appointed:

Committee on Nominations—Junea W. Kelly, W. H. Behle, and J. T. Marshall; Committee to Examine Proxies—T. R. Howell, R. T. Orr, and K. E. Stager.

The following proposals for membership were read: James R. Northern, Los Angeles County Museum, Exposition Park, Los Angeles 7, California, by K. E. Stager; Prof. F. Carlos Lehmann V., Apartado Nacional 680, Cali, Colombia, South America, by A. H. Miller; Jack B. Woody, 4 Humboldt Village, Arcata, California, by F. H. Boynton; Richard E. Warner, Division of Fish and Game, P. O. Box 5425, Honolulu 14, Hawaii, by W. J. Sheffler; Clifford H. Fiscus, 841 Sullivan Street, Seattle 8, Washington, by R. T. Holmes; James R. Koplin, 1632 South Russell

Street, Missoula, Montana, by R. S. Hoffmann; Mrs. Viola E. Washburn, 1013 Walnut Avenue, Santa Cruz, California, by H. R. Smith; Robert Grant Crippen, Museum of Vertebrate Zoology, Berkeley 4, California, by R. C. Banks; Mrs. Harriet Humphrey Burkhart, Route 3, Canadohta Lake, Union City, Pennsylvania, by W. C. Hanna; William C. Beckwith, 833 15th Street, Santa Monica, California, by T. R. Howell; Douglas Bruce McHenry, 168 West Third North, Logan, Utah, by G. H. Linford; Arthur J. Frank, 2534 N. Terrace Avenue, Milwaukee 11, Wisconsin, by S. B. Peyton; Mrs. Ernest B. Keyt, 657 36th Street, Manhattan Beach, California, R. Wayne Moody, M.D., 1169 Colorado Boulevard, Denver 6, Colorado, and Craig Smith, 301 Wyckoff Avenue, Ithaca, New York, by J. C. von Bloeker, Jr.; Thomas Fisher Hamilton, 1928 Mandeville Canyon Road, Los Angeles 49, California, and John R. MacFaden, 417 South Hill Street, Los Angeles, California, by E. N. Harrison; Dean Torrence, 2145 Benecia Avenue, Los Angeles 25, California, Richard McPike Brown, Crater Lake National Park, Fort Klamath Rural Station, Klamath Falls, Oregon, and Helen M. Alexander, 2121 West 9th Street, Los Angeles 6, California, by C. V. Duff.

There being no further business, the meeting was adjourned until April 26.

The second session of the annual meeting of the members of the Corporation was called to order by President J. R. Pemberton in the Little Theater, New Union Building, University of Utah, Salt Lake City, Utah, on April 26, 1958.

Thomas R. Howell, chairman of the Committee to Examine Proxies, reported proxies for 892 members. A quorum was declared present.

Mrs. Junea W. Kelly, chairman of the Committee on Nominations, presented the following names for nomination to the Board of Directors: John Davis, C. V. Duff, Ed N. Harrison, Thomas R. Howell, Alden H. Miller, J. R. Pemberton, Frank A. Pitelka, W. J. Sheffler, and Jack C. von Bloeker, Jr.

President Pemberton called for further nominations from the floor. There were none. C. V. Duff moved that the nominations be declared closed and that the Secretary be instructed to cast an unanimous ballot for those named. The motion was seconded and carried unanimously.

C. V. Duff presented the following resolution:

The members of the Cooper Ornithological Society, in their annual session at the University of Utah, wish to express their deep appreciation to Dr. Olpin, President, and to the Board of Regents and Faculty of the University of Utah, for their generous provision of the splendid facilities that have made the meeting so pleasant for all.

Further, we wish to express our gratitude to Dr. William H. Behle, Mrs. Fern Tainter, and Dr. Stanley Mulaik and their Local Committee, and to the Utah Audubon Society and the Utah Nature Study Society, for all their efforts that have made this one of the outstanding Annual Meetings in the Society's history.

Further, we wish to express our thanks to Dr. and Mrs. George A. Allen and family for their delightful hospitality on the tour of the Allen Aviary on Thursday, April 24, 1958.

It was moved, seconded, and carried unanimously that this resolution be adopted.

C. V. Duff, Business Manager, presented his annual report. During the year, 282 shares in stock dividends were received by the Society. Income during the past year was $4351, $571 more than in 1957.

The following proposals for membership were read: Leon Stanley, 129 F Street, Salt Lake City, Utah, by J. Davis; Herbert Krause, 1811 South First Avenue, Sioux Falls, South Dakota, by W. Taber; Stephen C. Bromley, 9359 Gotham Street, Downey, California, by K. E. Stager; Donald Daynes, 1812 Herbert Avenue, Salt Lake City, Utah, by S. B. Peyton; Floyd A. Thompson, 232–F S.W. South Temple, Salt Lake City, Utah, Paul E. Trapier, 2830 E. 37th Street South, Salt Lake City, Utah, Jessop B. Low, Utah State University, Logan, Utah, and Reed Ferris, 941 S. 13th East, Salt Lake City, Utah, by C. V. Duff.

—JOHN DAVIS, *Secretary*.

For Sale, Exchange, and Want Column—Each member of the Cooper Society is entitled to one short advertising notice in any issue of the Condor free. Notices of over 3 lines will be charged for at the rate of 25 cents per line. Send advertising copy to Jack C. von Bloeker, Jr., Los Angeles City College, 855 N. Vermont Ave., Los Angeles 29, California.

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July 1, 1958

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